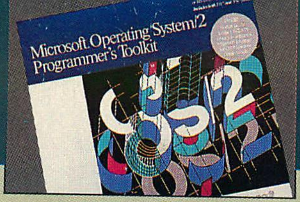
DEVELOPING UNDER OS/2▸



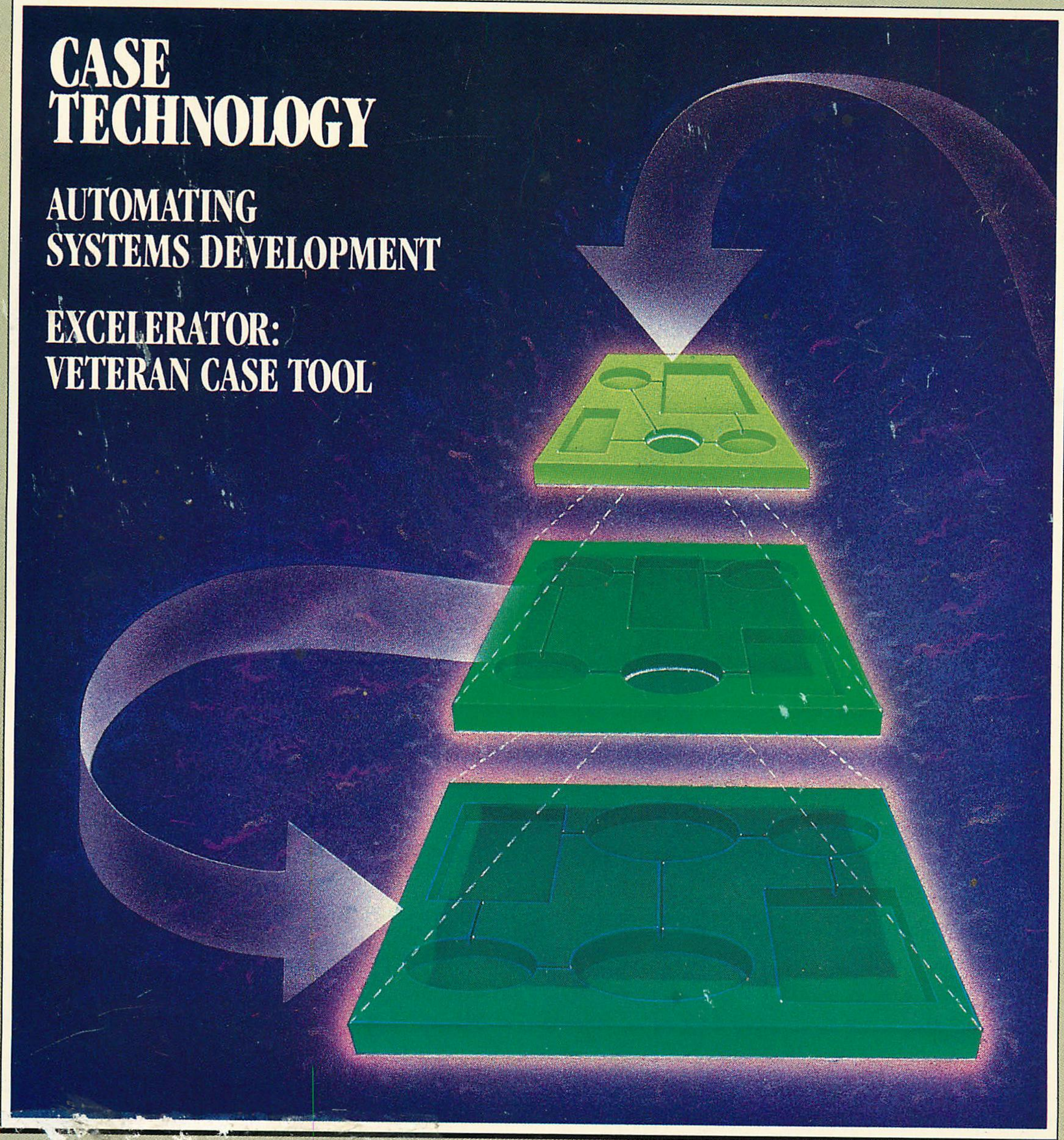
PREMIUM/386 FROM AST

AUGUST 1988

VOL. 6 NO. 8 $3.95

PC TECH JOURNAL®

FOR SYSTEMS DEVELOPERS AND INTEGRATORS



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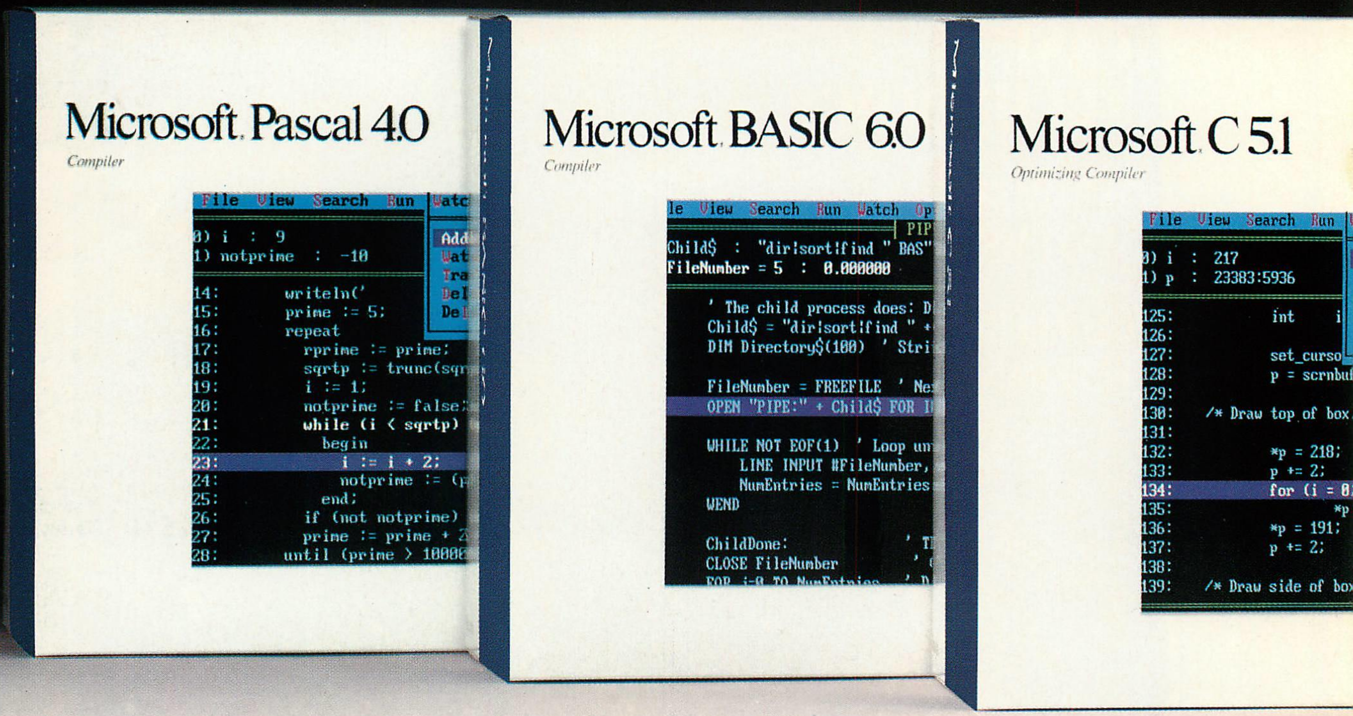
for OS/2



The people who co-developed the industry's most powerful personal computer operating system are now proud to announce programming languages to match.

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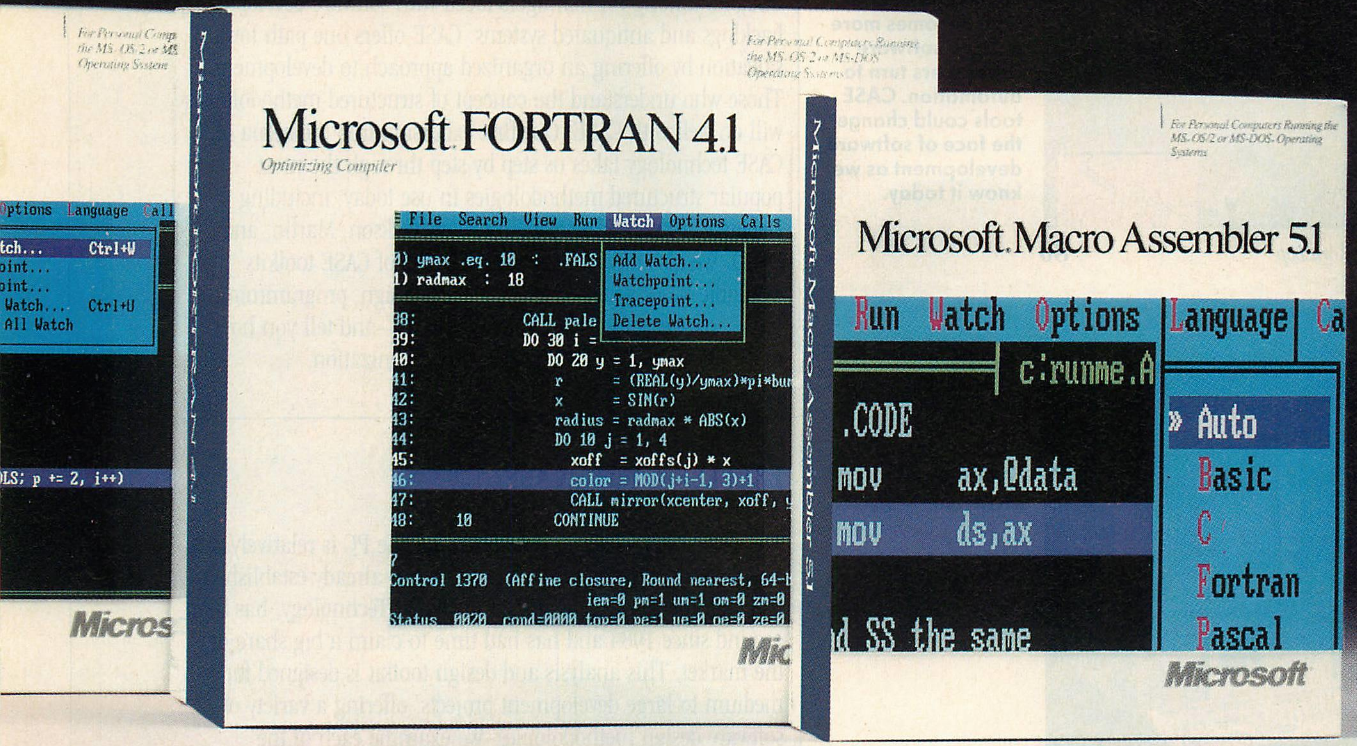

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As the perfect complement to our new languages, we're also offering the Microsoft OS/2 Programmer's Toolkit.

It contains a parameter-by-parameter breakdown of all OS/2 system calls and samples to get you started.

All the tools you need for turning out larger, more powerful, more complex OS/2 applications.

(And, incidentally, all the tools we rely on for creating our own commercial software.)

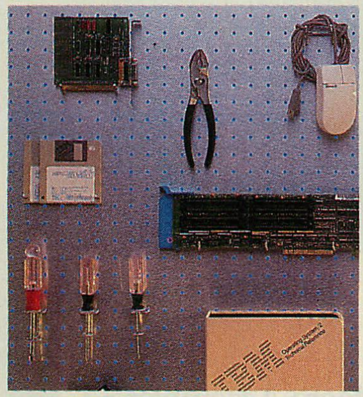
For the name of your nearest Microsoft professional languages dealer, simply call 800-541-1261, Dept. C16.

Ask him for some more information on our OS/2 family.

He'll show you some languages you can really swear by.

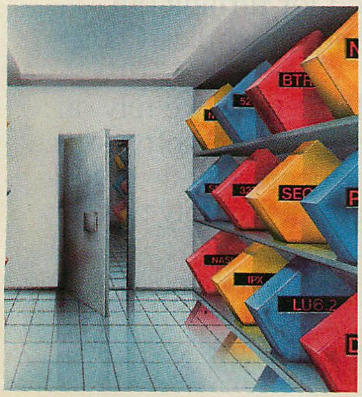
PC TECH JOURNAL

FOR SYSTEMS DEVELOPERS AND INTEGRATORS



COVER SUITE: CASE TECHNOLOGY

As programs grow longer and more complicated, and time becomes more critical, software developers turn to automation. CASE tools could change the face of software development as we know it today.



APPLICATION DEVELOPMENT

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PC TECH JOURNAL

VOL. 6, NO. 8

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BPA

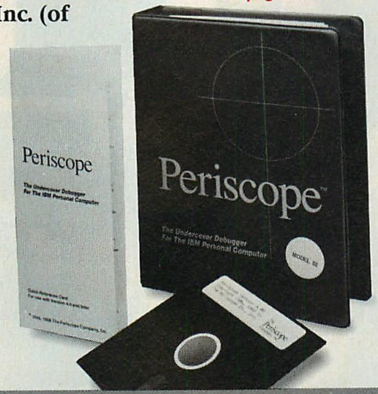
Periscope's *New* Version 4

...Gives you all the right stuff for debugging! No matter which model you pick, you have the same powerful software to help you track down hard-to-find bugs fast.

David Nanian, President of Underware, Inc. (of BRIEF fame) says this about the new Periscope Version 4:

"Periscope has always been an unbelievable assembler-level debugger. Version 4 has turned it into a terrific source-level debugger as well. Aside from major enhancements like the source-level improvements, all the little changes make a really big difference, too. For instance, symbol lookups and disassemblies are noticeably faster, and highlighting the registers that have changed really makes life easier. Once again, Periscope has raised the industry standard for debuggers!"

Periscope software & 250+ page manual

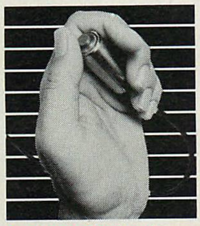


Periscope's software is solid, comprehensive, and flexible.

It helps you debug just about any kind of program you can write . . . thoroughly and efficiently.

Periscope's the answer for debugging device-drivers, memory-resident, non-DOS, and interrupt-driven programs. Periscope works with any language, and provides source and/or symbol support for programs written in high-level languages and assembler.

Periscope's hardware adds the power to solve the really tough debugging problems.

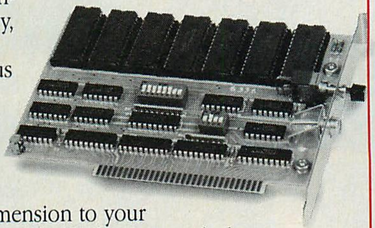


Periscope Break-out Switch

The break-out switch lets you break into the system any time. You can track down a bug instantly, or just check what's going on, without having to reboot or power down and back up. That's really useful when your system hangs! The switch is included with Periscope I, Periscope II, and Periscope III.

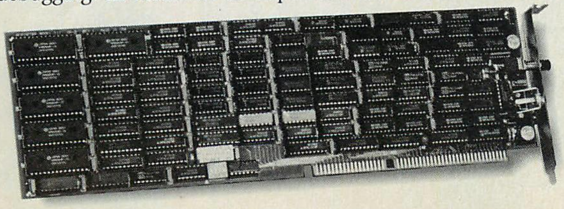
Periscope I has a board with 56K of write-protected RAM. The Periscope software resides in this memory, safe from run-away programs. DOS memory, where debugger software would normally reside, is thus freed up for your program.

Periscope I Board



Periscope III has a board with 64K of write-protected RAM, which performs the same function as the Periscope I protected memory. AND . . .

The Periscope III board adds another powerful dimension to your debugging. Its hardware breakpoints and real-time trace buffer let you track down bugs that a software-oriented debugger would take too long to find, or can't find at all!



Periscope III Board

What's New in Periscope Version 4:

- View local symbols from Microsoft C (Version 5)
- Debug Microsoft windows applications
- Set breakpoints in PLINK overlays
- Improved source-level support
- Monitor variables in a Watch window
- 80386 debug register support
- Debug using a dumb terminal
- PS/2 watchdog timer support
- Use mixed-case symbols
- Set breakpoints on values of Flags
- Much more!

- **Periscope I** includes a half-length board with 56K of write-protected RAM; break-out switch; software and manual for **$455**.
- **Periscope II** includes break-out switch; software and manual for **$175**.
- **Periscope II-X** includes software and manual (no hardware) for **$145**.
- **Periscope III** includes a full-length board with 64K of write-protected RAM, hardware breakpoints and real-time trace buffer; break-out switch; software and manual. Periscope III for machines running up to 10 MHz is **$1395**.

REQUIREMENTS: IBM PC, XT, AT, or close compatible (Periscope III requires hardware as well as software compatibility); DOS 2.0 or later; 64K available memory; one disk drive; an 80-column monitor.

Call us with your questions. We'll be happy to send you free information or help you decide on the model that best fits your needs.

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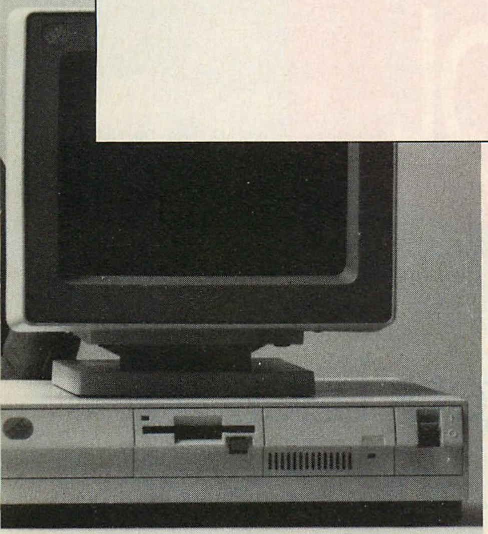
CIRCLE NO. 215 ON READER SERVICE CARD

Here's a radical idea: give people who work together the means to easily share information among PCs—but don't force them to become computer experts to do it.

Here's another one. Make this network so simple to install that you can set up the whole thing in oh, say, a half hour or so.

Presenting TOPS.®



MORE NETWORK. LESS NET WORK.

With the TOPS Network, you and your co-workers can access files from each other's computers exactly as if they were sitting on your own PC or hard disk. And even print out those files (with our TOPS NetPrint™ software) directly to any printer that supports the "PostScript®" language, such as Apple's LaserWriter.™ All through easy-to-use menu commands.

The result is the very comforting—and productive—feeling of being able to concentrate on the work at hand, instead of on having to learn the network.

On a TOPS Network, every computer can share files directly with any other, thereby sharing the load of the entire network. The result is that you don't have to purchase an expensive central file server. Or shut down the network when you want to add a new computer. Or hire an extra person to manage the whole affair.

And setting up TOPS is just as straightforward. You can install the necessary network card—such as our TOPS FlashCard™—in no more than twenty minutes. Loading the TOPS software? We've unofficially clocked it under five minutes.

As if all that weren't enough, TOPS runs over common twisted-pair cabling, such as regular phone wire. Just add an easy-to-install network connector—such as the TOPS TeleConnector—at each node. And at only $189 for the software, and $239 for each TOPS FlashCard, TOPS is the least expensive way to get your workgroup working together.

Of course with TOPS, PC-to-PC communication is just the beginning. Because without sacrificing simplicity, we also offer products that let you share information just as easily with other networks and systems, including Macintoshes™ and Sun® workstations.

Want more information? Give us a call at 800-445-TOPS (from outside the U.S. and Canada, call 415-769-8700). Or write to us at TOPS, 950 Marina Village Parkway, Alameda, California 94501.

After that, it gets easier.

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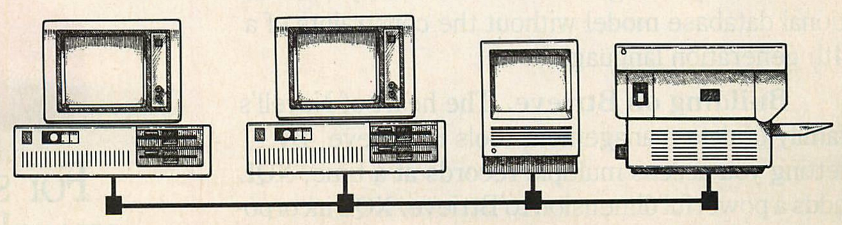

With TOPS, it's easy to share information among PCs—and other systems, too.

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Finally, there's an SQL that gets back to BASIC. And COBOL. And C. And Pascal.

As a programmer, you've probably already faced it—the database dilemma. Do you use an SQL for easy database handling, or a true programming language for maximum power and flexibility?

Now you can do both with XQL,® the relational data management system from the developers of Btrieve.®

The Programmer's SQL. With XQL, you can access your data with the ease of Structured Query Language through simple subroutine calls from traditional programming languages. XQL supports standard SQL syntax, including subqueries, unions and security groups.

XQL Relational Primitive Operations. In addition, XQL lets you bypass the SQL level and perform highly efficient, relational primitive operations directly. You get all the functionality of a relational database model without the constraints of a 4th generation language.

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Solve the database dilemma with XQL, the SQL that speaks your language. Only $795.* See your Authorized Novell Gold Reseller, or call us at (512) 346-8380.

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Requires Btrieve 4.x and PC-DOS or MS-DOS 2.x, 3.x.

CIRCLE NO. 201 ON READER SERVICE CARD

JULIE ANDERSON

Tailored Applications

Achieving just the right fit in an application leads to frustration if you skip the planning stages. CASE tools can help.

Software development is a long and arduous process, which is why releases of software lag months or even years behind the introduction of new hardware. Witness the current slowdown in the software market. IBM introduced the AT—the first 286 machine—in August 1984; however, it took Microsoft three years to release the first OS/2 developer kits in July 1987. OS/2 applications finally began to appear in the first quarter of 1988. Meanwhile, pressure is mounting to develop software that will exploit the 386's flat 32-bit address space.

Software development is such a difficult undertaking because it requires a variety of skills—creativity and sensitivity to users' needs as well as systematic application of proven methodologies. In addition, as with any process involving humans, it is expensive and prone to errors.

Despite the number of tools designed to make developers more productive and less susceptible to human imperfections, many software projects are delivered well past deadline and substantially over budget. Some fail completely and their products are never released, because either they do not satisfy users' requirements, or technology has advanced so far that the applications are obsolete before they see the light of the display.

This is not surprising considering the responses to our Reader Opinion Card in the May issue when we asked you to name your biggest software development problem. (For a full report, see this month's Professional Viewpoint on page 160.) Card after card, readers complained that their biggest problem is figuring out what users want.

The reason these developers are frustrated may be that many of today's tools concentrate on easing only the back end of the software development process. These tools are designed to facilitate the reiterative process of coding, testing, and debugging. They pipe data from the program editor to the compiler, to the debugger, and back to the editor. Certainly, this is the situation Borland's Turbo and Microsoft's Quick development environments are designed to address.

Long before the program editor is invoked, however, substantial time must be invested in painstaking upfront planning. Frankly, planning is not much fun, and without good analytical tools, developers are easily tempted to skimp on this stage or skip it entirely. Planning certainly does not deliver the short-term feedback that comes from stepwise development—adding code incrementally, testing it, and seeing the new code run to completion. Nevertheless, planning and prototyping lay a strong foundation for a successful software application.

This is why computer-aided systems engineering (CASE) tools are needed. CASE tools ease the burden on developers by providing a structure on which to determine the users' requirements and design the application from the top down. The high-level design is then functionally decomposed and further refined until the program is ready to be coded. Further, CASE tools help to analyze the specifications developers build by cross checking data items for consistency and redundancy. Some CASE tools also provide links to program generators to give the coding process a head start.

CASE IN POINT

CASE is not a new concept, although it is relatively new to microcomputers. In this month's cover suite, author Carma McClure introduces the CASE field to the uninitiated. In "The Case for Structured Development" on page 50, McClure describes the popular design and analysis methodologies of DeMarco, Gane and Sarson, and Yourdon, among others, and surveys PC CASE tools, most of which support a variety of these methodologies.

In the second article on page 70, "Excelling with CASE," Andrew Topper reviews Index Technologies' Excelerator, the most popular PC CASE tool at this time. One of Excelerator's strengths is its prototyping tools for screens and reports.

Tools such as these help tremendously in figuring out what the user wants and needs. Too many times, developers show the end users the functional specification for the application and expect them to sign off on the design. This is as ludicrous as a car

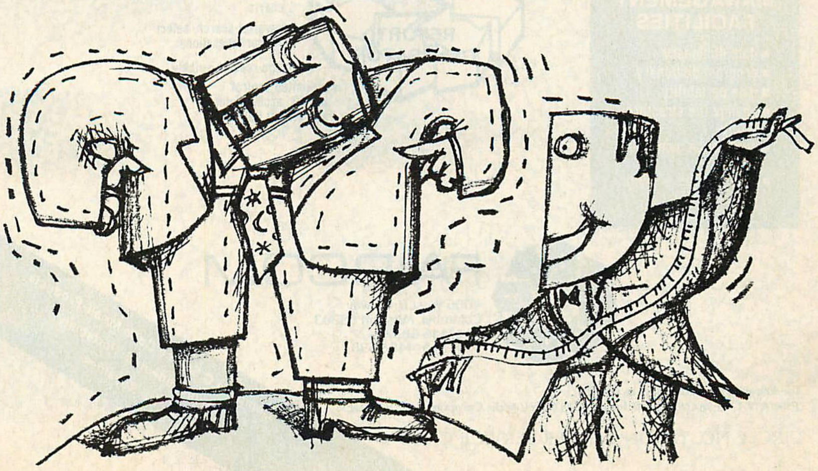

ILLUSTRATION • MACIEK ALBRECHT

dealer showing you the schematic design of a car's engine, and then, without allowing you to get behind the wheel, asking you to buy the car.

End users need to touch and feel an application, to take it on a test drive by working through transactions with real data. Only then can users know if the right questions are asked, if the right data are displayed, and if the application is easy to use.

Ideally, CASE tools should support the developer throughout the complete software life cycle. In reality, however, this does not work. One reason stems from CASE's mainframe roots, which have not been transplanted well into the microcomputer environment. For example, some CASE tools link to a program generator, but it is almost always to a COBOL compiler, instead of to C or one of the other popular microcomputer languages.

As a result, once the design is complete, code development splits into a separate and independent activity. Changes to the design, which inevitably occur during the coding stage, must be manually entered into the CASE system, and any documentation that was produced automatically from the specification must be regenerated. When the automatic correlation between design, code, and documentation breaks down, maintaining the three threads separately requires extra effort and leaves open the opportunity for errors.

Despite the lack of continuity of tools from design to release of an application, many microcomputer developers use CASE-like tools to manage at least part of the process. Dan Bricklin's Demo Program from Software Garden is a popular prototyping tool. Some developers find an outline processor such as Living Videotext's ThinkTank 512 useful to decompose and refine a program's design.

DataEase from DataEase International produces custom documentation automatically. This is a clever idea based on the fact that DataEase applications have much in common operationally, differing only in the custom menus and reports. Further, program generators are often included with data managers to code the more routine modules of the application from the screen and report designs.

The tools are there for managing the entire life cycle, although they are available only in bits and pieces. The challenge is in providing the common thread for integrating all parts seamlessly into the whole.

The SAS®

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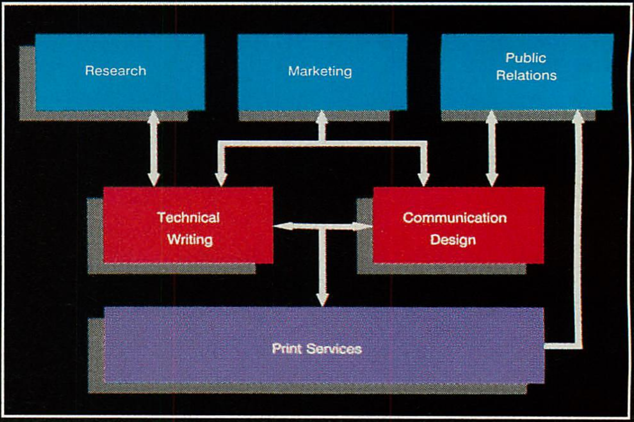

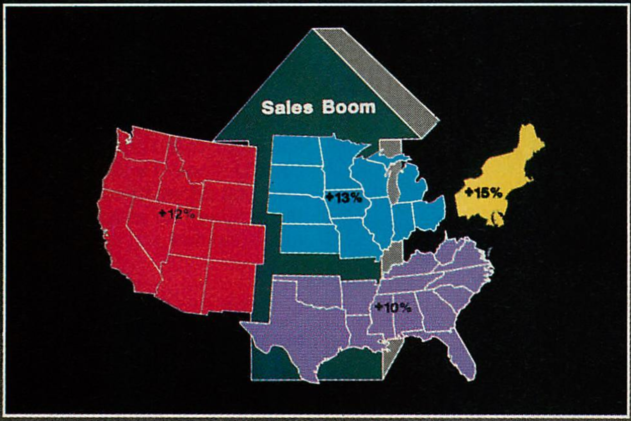

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The SAS System has integrated applications to use "as is" or customize to fit your needs. Plus a built-in micro-to-host link just for your PC.

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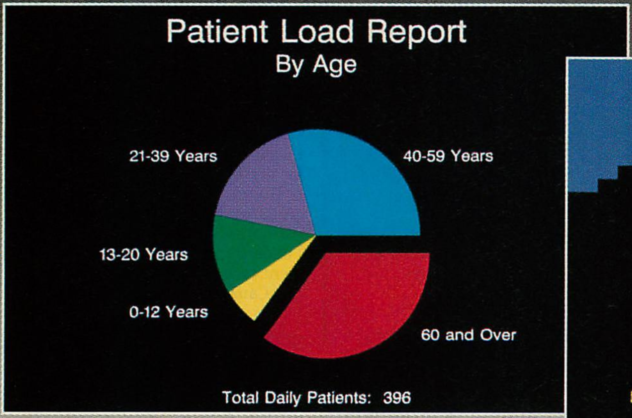

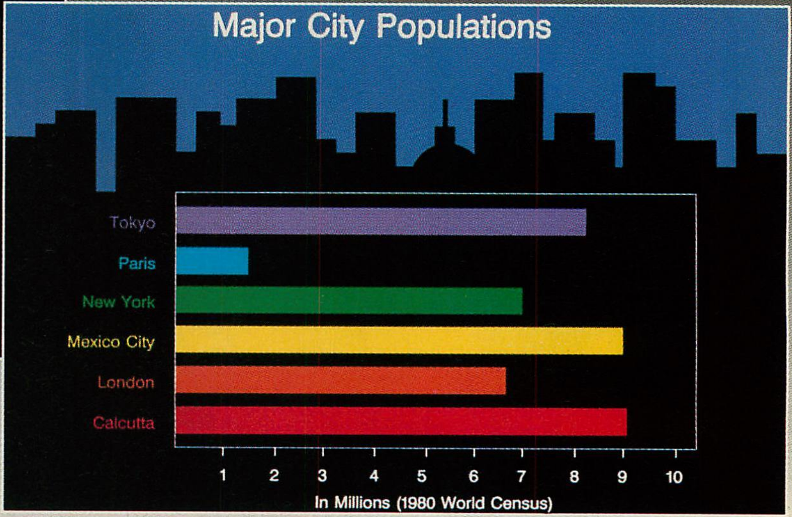

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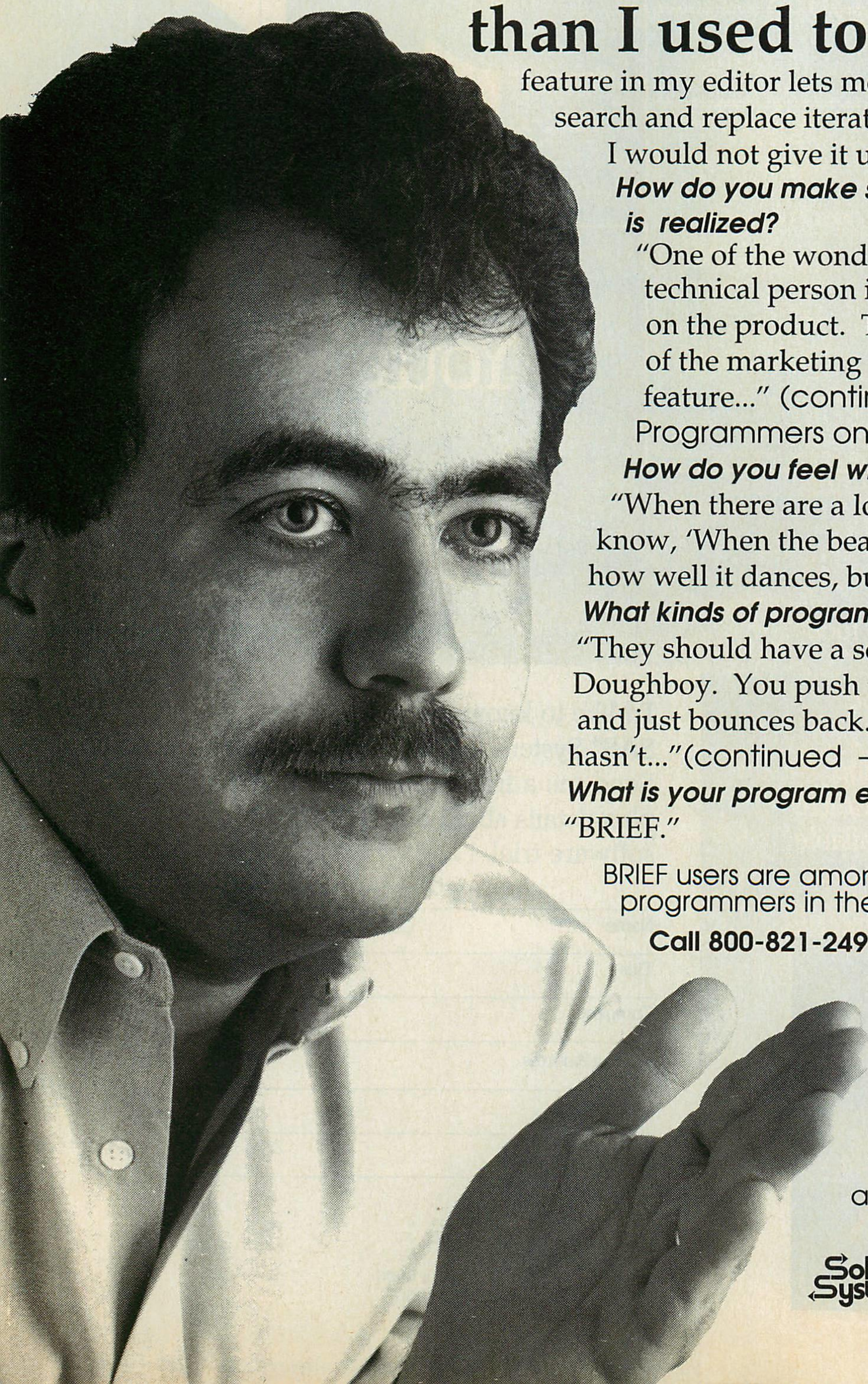
World Class Programmers on Creativity

Dan Sevush. Project Leader on Lotus 1-2-3.
Principal Engineer on Agenda.
Author of Speedup.

How do you overcome a creative block?

"I keep a music synthesizer within pounding range. I'll improvise while I do low-level work. I can loosen up by letting my hands wander on the keyboard. Sometimes I experiment with "programming" the sounds — like, What does a piano sound like if it's bowed and played underwater in a glass dome?"

And when you're back at your computer?



"I suffer less for my creativity than I used to.

When I experiment, the UNDO feature in my editor lets me reverse up to 300 steps. A whole search and replace iteration is treated as a single step. I would not give it up."

How do you make sure your vision of a program is realized?

"One of the wonderful things about being a technical person is that you really have the final call on the product. This can drive fear into the hearts of the marketing people. If you oppose a particular feature..." (continued in "World Class Programmers on Creativity" — see below.)

How do you feel when a project comes to an end?

"When there are a lot of people, it's mostly relief. You know, 'When the bear dances, you marvel not so much how well it dances, but that it dances at all.'"

What kinds of programmers do you like to work with?

"They should have a sense of humor. Like the Pillsbury Doughboy. You push the Doughboy and he goes "Naaaa" and just bounces back. And I don't hire anyone who hasn't..."(continued — see below.)

What is your program editor?

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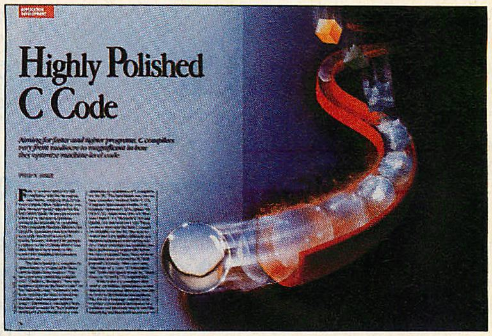
LETTERS


Novell Advances


Highly Polished C Code

FIT TO PRINT

In your article on Novell ("Novell Advances," Steven S. King, June 1988, p. 58), your discussion mentioned that one reason Novell is good is because of its print server/file server. However, in my opinion, this is its main problem. If you send more than 99 documents to the print/file server for printing, the 99+ documents disappear. Novell was notified of this problem, but the response was, "It is not a problem." In fact, NetWare does not handle spooling efficiently. The spooler should respond to the workstation with a printer busy signal when the spool is filled up. Instead, the spooler just throws away any documents after 99 are in the spooler. It would be nice if Novell would correct a major defect such as this one.

Jeff Jacobson
Household International
Prospect Height, IL

Novell acknowledges the problems with its print services but indicates they have been addressed in NetWare 2.1 (the version reviewed in the June 1988 issue). NetWare 2.1 increases queue capacity to 250 jobs and corrects bugs such as the printer busy notification. For backward compatibility, version 2.1 still supports the older printing calls—for example, subfunctions 00 and 01 of function E0. Even in version 2.1, the E0 functions support lower queue capacity (fewer than 100 jobs) and have bugs that will send a print job to the bit bucket when the queue is full. Applications such as WordPerfect 4.2 that still use the older calls do not take advantage of NetWare 2.1's enhanced print services.

As for Mr. Jacobson's questioning of whether Novell services are "good," qualitative judgments in the network industry are relative; compared with other products, Novell has traditionally been acknowledged to supply excellent print and file services. Those who work only in the Novell environment may not realize how Novell's services compare with that of other vendors.

—SSK

LIGHTING UP DATALIGHT

I'm generally quite pleased with the article, "Highly Polished C Code," by Philip N. Hisley (June 1988, p. 76). However, I was disturbed by the statement that Datalight Optimum C did not do any loop optimizations. Because I wrote Datalight Optimum C, I know that it *does* do loop invariants and loop induction variables.

Turning to the benchmark listings, the reason that the optimizations were not performed is because the loop index variables were globals. Datalight Optimum C uses a very conservative approach to optimizing global variables, due to the aliasing problem. The rule used internal to the optimizer is that if a global variable is modified, then it is assumed that all global variables might have been modified. This is because the actual storage layout of globals may be defined in another file, which the optimizer can know nothing about. The globals may wind up overlapping each other. In the benchmark loop code, when the assignment is made to the array, it is possible that the loop index was also modified, and so the optimizations are ruled out.

If the loop indices *i*, *j*, and so on are made automatics, all the expected loop optimizations are performed. In any case, the use of global variables should be minimized to avoid any reentrancy problems (this will become apparent when programming for OS/2).

Worst-case aliasing assumptions will cause the compiler to miss some optimizations, but I feel that it will still catch the worthwhile ones. Relaxing the worst-case assumptions can lead to some very subtle bugs if the programmer is not aware of exactly what assumptions are being made. These statements also apply to dead assignment elimination. I suggest that the benchmark be modified to make the variables *i*, *j*, *k*, . . . *k5* automatics.

I would like to take exception to the statement in the comparison chart (table 2) that Datalight C does not support intrinsic functions. Datalight C was the first MS-DOS compiler to support intrinsic functions (the I/O port functions are in-lined). They simply are not called intrinsic in the manual; the first time I encountered the phrase *intrinsic* in referring to in-lined functions was in the Microsoft C manual.

Walter Bright
Kirkland, WA

As the article mentioned, the results in table 2 apply only to the benchmark code; similar cases in real-life code may not be optimized the same way by a compiler. Because the analysis requires much manual examination of the generated code, the challenge is to portray as many common opportunities for code optimization without making the benchmark unwieldy.

In real programs, global variables should not be used for loop control. Because the benchmark should reflect realistic code, that part of the benchmark will be changed accordingly. A similar situation arises with the simple loop code shown in figure 2. This code was translated from the Modula-2 code used in review of Modula-2 ("Modular Developments," John Cockerham, March 1987, p. 114). In C, most programmers would write the line k5 = k5 − 1 as k5 − −. We will be experimenting with more typical C code to replace this part of the benchmark. As we refine this benchmark for future articles, we will use your comments and others to improve its worth.

Datalight's conservative approach to optimization is admirable; a correct answer at any speed is preferable to a

quick wrong answer. [Note that since the article appeared in June, the Datalight Optimum C compiler was sold to Zortech Inc.]

—DWM

QB4 PRECISION PROBED

I liked Mr. Crom's review of QuickBASIC 4.0 (Product Watch, Justin Crom, May 1988, p. 149) very much. However, concerning his statement that QuickBASIC 4.0 in the Editor environment did not give the right answer to the SAVAGE benchmark, it should be noted that a similar failure results when the program is run in a standard BASICA interpreter in single precision.

The results that follow summarize a number of runs of SAVAGE on an XT compatible that has been upgraded by adding an Intel Inboard 386 with an 80387 coprocessor. This system has a Norton SI 3.0 rating of 15.3. The same tests were run on an unmodified IBM PC/XT with exactly the same answers, but with run times ranging from 5.17 to 6.72 times as long.

It is probably significant that in double precision, the QuickBASIC Editor environment is more accurate than the interpreter. Thus, Mr. Crom's suggestion about the cause of the poor performance of the Editor run may not be right. More likely, it is a traditional round-off error resulting from the way in which the round-off is handled. After all, requiring 24,999 passes through that SAVAGE function is tough stuff.

Microsoft is indeed to be congratulated that the single-precision run using the QuickBASIC 4.0 .EXE file is so precise—in fact, it is astounding. Very careful attention must have been paid to the round-off procedure.

I am helping to debug a compiler that is still under development, but it already works well enough to give the last result listed. Note that it gives a better answer than does the QB4 .EXE file and is some 29 percent faster (QB4 takes 42 percent longer).

QB4 4.0 Editor, double precision
Loop Limit = 25,000
Run Time = 12.0859375
Answer = 24,999.99999723873

QB4 Editor, single precision
Loop Limit = 25,000
Run Time = 12.13281
Answer = 4,099.735

QB4 compiled .EXE file, double precision
Loop Limit = 25,000
Run Time = 8.5078125
Answer = 25,000.00000000173

QB4 compiled .EXE file, single precision
Loop Limit = 25,000
Run Time = 8.453125
Answer = 25,000

GW BASICA 2.02 (interpreter), single precision
Loop Limit = 25,000
Run Time = 224.4219
Answer = 4,670.071

GW BASICA 2.02 (interpreter), single precision (repeated)
Loop Limit = 25,000
Run Time = 224.3125
Answer = 4,670.071

Interpreter, double precision
Loop Limit = 25,000
Run Time = 586.265625
Answer = 24,999.99997049145

Compiler still under development, .EXE file, double precision
Loop Limit = 25,000
Run Time = 5.9921875
Answer = 25,000.00000000044

C. W. Tittle, professor of physics
Southern Methodist University
Dallas, TX

Professor Tittle is correct in that a standard BASICA interpreter running a single-precision version of the SAVAGE benchmark will give erroneous results similar to those generated by the p-code version of QuickBASIC 4. In contrast, the .EXE file generated by the QB4 compiler from the same single-precision source code yielded the same result.

As stated in the review, Microsoft suggested the performance difference between .EXE and p-code versions is due to p-code using 8-byte temporary variables in contrast to the .EXE's 10-byte temporaries. The review went on to point out that Microsoft's explanation did not reveal why the error rating measured by the ACCURACY program is better for p-code than for .EXE files.

That the performance of .EXE files generated by QB4 can differ from the p-code performance in the Editor should signal caution to the developer.

—Justin Crom

FILE-HANDLE POINTER

Ted Mirecki's description of the manner and method of increasing file handles in MS-DOS 3.30 (Tech Notebook, April 1988, p. 161) is informative and very useful. However, I find the following comment not entirely accurate: "Since version 3.0, DOS has made no assumptions about the location and

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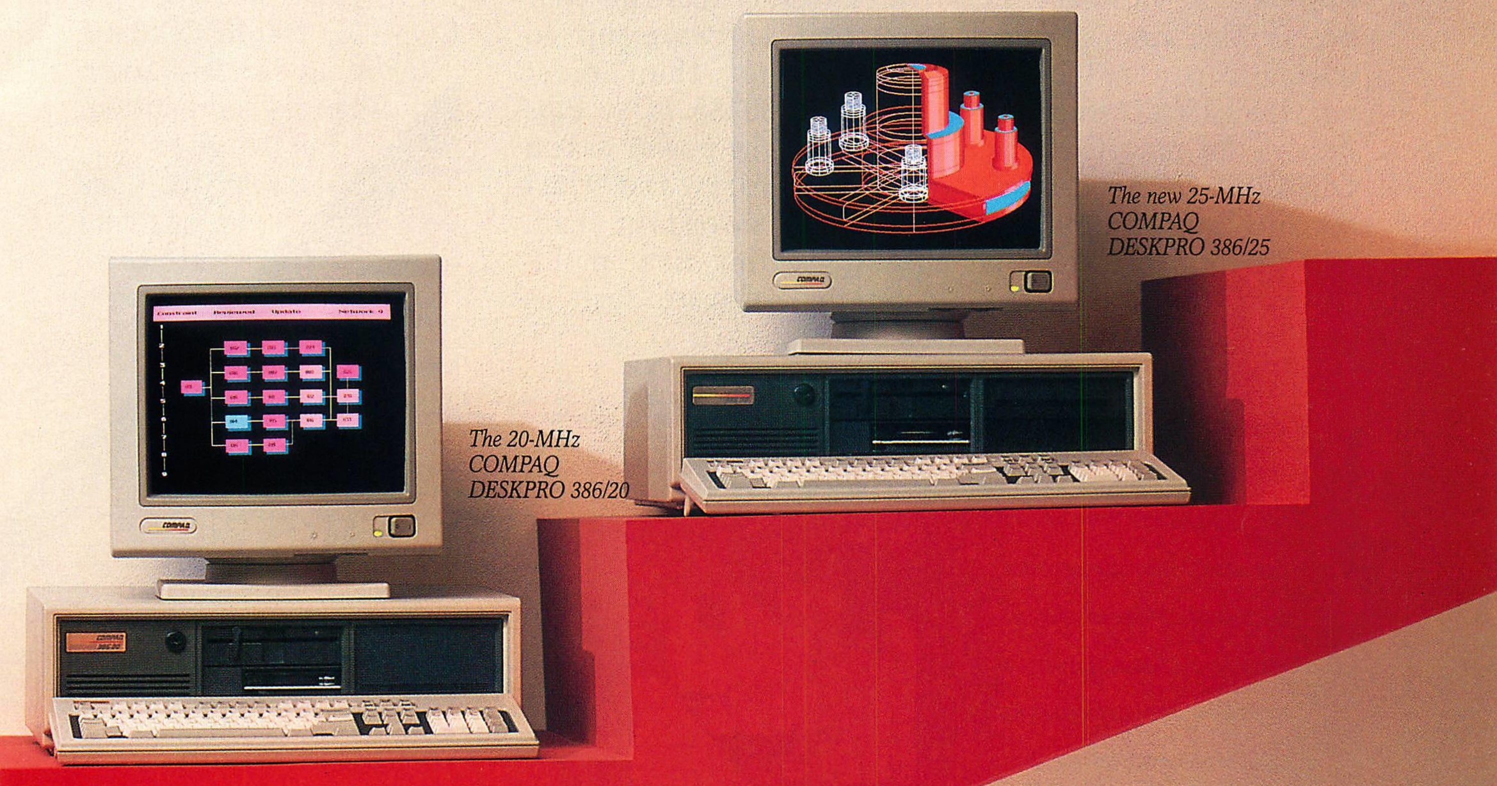

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length of the [file handle] table and is perfectly happy to find it by means of the pointer in the PSP, whether or not the table is in the PSP."

COMMAND.COM, in its INT23 and INT24 handlers, as well as in other parts of its code, sets and resets STDIN and STDOUT by directly modifying bytes 18H and 19H in the PSP. (These are pointers for file handles 0 and 1, if the PSP file handles are being used.)

Since COMMAND.COM usually would not execute until the application program using the extended file handles terminates, this would not normally cause a problem, as long as the application program uses its own interrupt handler for INT23 and INT24. If it does not, then COMMAND.COM's attempts to reset STDIN and STDOUT will fail, because the file-handle table in the PSP is no longer accurate.

COMMAND.COM's direct manipulation of the file-handle table would also cause problems if the application program created a shell by loading another level of COMMAND.COM, but Mr. Mirecki clearly documented the shortcomings of DOS's EXEC function in this regard.

Hopefully, version 3.4 of DOS should cure these shortcomings, but if so, it will be at the cost of backwards compatibility. OS/2 is looking better and better all the time!

John R. Switzer
Manzana Microsystems Inc.
Goleta, CA

DOS is notorious for breaking its own rules, and Mr. Switzer has found an example of this. However, this particular anomaly usually does not cause problems, even with the standard interrupt handlers, because COMMAND.COM assumes a fixed location for its own handle table but not for the table of the application program. There is little reason to move COMMAND.COM's table, so in most cases the assumption will be correct.

—TM

SECURITY SYSTEM CLARIFIED

We appreciate the in-depth evaluation of our Triad Plus product (Product Watch, Art Krumrey, June 1988. p. 139). Not surprisingly, for a security product that is designed to confuse hackers, the review expresses some misconceptions.

First, we are pleased that Triad Plus's efficiency makes the product appear to have its own processor; in fact it achieves this high level of transparency solely through its firmware.

Second, a good network security system is not a substitute for installing a security product on each PC using that network. Typically, networks are open channels for cleartext data. In fact, many network channels are tapped multiple times at each user's office and subject to covert compromise. Triad Plus automatically encrypts the information traveling along these channels.

Third, the National Computer Security Center evaluated Triad Plus and placed it on its evaluated subsystems list, which is the highest level any PC security subsystem has attained. The product has no rating of PC-2 as claimed by the reviewer.

The reviewer cited restrictions of board address space and interrupt level; these limits are true for Triad Plus. Your readers may want to inquire about a more recent Micronyx product, TriSpan (available since last winter), which has all the security features of Triad Plus and can be mapped to any of six address ranges and six interrupt levels.

W. Mark Goode, president
Micronyx Inc.
Richardson, TX

First, our apologies for the errors in the review of your product. Very little theory of operation was included in the documentation, because a detailed description of the operation of the Triad Plus board might make it easier to defeat. Triad Plus uses unmarked components for the same reason. Although the board does not have its own CPU, it does contain hardware to expedite the encryption and decryption process. This makes it noticeably faster than software-only encryption products.

Cabling is not only a vulnerable area for networks but also one that requires sophistication to breach. Office snoops will be thwarted by a strictly applied LAN security system such as the one in Novell's NetWare. Because Triad Plus only encrypts the data, the LAN security system is still used to ensure that acts such as file deletion are stopped. The need for Triad Plus depends on the value of the data being protected and the cost of their disclosure. Selected LAN workstations can be protected by Triad Plus, so the cost-benefit trade-off is easier to make.

When PC Tech Journal *requested the Triad Plus product, we were not aware of the TriSpan product, which costs $895. Triad Plus is still being marketed for $695.*

—DWM

FOLKLORE FOLLOW-UP

I very much enjoyed Peter Coffee's June 1988 column ("Folklore, Fear—and Folly," p. 153) and agree with all but one point: Peter could have constructed his printer-control file using DEBUG, a utility generally provided with DOS. All one has to do is start DEBUG, enter the appropriate string, set register CX to the length of the string, name the file, and then write it.

Of course, this method requires its own special folklore and may not be obvious with later versions of DOS since IBM decided to place DEBUG documentation into the *Technical Reference instead of the DOS manual.*

Tom Simondi, president
Computer Knowledge
Los Angeles, CA

As a consultant working with PCs for the past several years, I've had too many experiences similar to those described by Peter Coffee in "Folklore, Fear—and Folly." I have a suggestion for developers: many applications boast of on-line, often context-sensitive, help. Why not link this feature to error handling? For example, Microsoft Word links context-sensitive help to a tutorial—a similar facility that suggests actions to correct errors seems like an easy, useful addition.

Kelly Kavanagh
Hayes-Mechling-Kleiman Inc.
Cambridge, MA

I thank the writers for taking the time to respond to the column. Outfitting the End User seems to have found its niche as a "report from the real world" to the development and systems integration community. The specific examples given in the June 1988 column made it one of the most popular to date; you'll be seeing the same kind of specifics in future columns as well.

—Peter C. Coffee

THE C SIDE OF THE BRAIN

One important factor has been neglected completely in the recent brouhaha over the merits of C expressed in the last several issues of your magazine ("C Contenders," Marty Franz, February 1988, p. 52; Letters, May 1988, p. 15; April 1988, p. 13; June 1988, p. 20).

I suspect that much of the antipathy and affection expressed towards C is merely a result of how poorly—or how well—the "world model" embodied in C maps onto the "world model" of the individual programmer. My guess is that the structure of C matches

well with the way some programmers think, and poorly with the thought processes of others. A good example of this divergence is the characterization of C as "cryptic" by some, and "concise" by others. Both are referring to C's famous lack of verbosity.

The popularity of C among readers who responded to your questionnaire tells me more about them than it does about the relative merits or popularity of C as a programming language.

Dean Brown
Manager, Computer Services
JLR Computer Analysis Inc.
Everett, WA

PUTTING THE PIXELS TO WORK

I just finished the article dealing with the IBM 8514/A graphics adapter ("Pixels with Panache," Ed McNierney, May 1988, p. 102). The article was good as far as it went. Now, I am starting to work with the 8514/A and need a lot more in terms of a technical exploration of the adapter and how to manipulate it. Can you provide a bibliography (outside of IBM) that gets into actually writing code for the 8514/A? Or, could you publish a more technically oriented article dealing with interfacing to and actually using the adapter?

Gary Lehnertz
IBM Corporation
Boca Raton, FL

Because IBM does not recommend programming to the 8514/A's hardware, it has not provided documentation for the hardware control system. Documentation for the 8514/A's software interface is contained in the IBM Personal System/2 Display Adapter 8514/A Technical Reference. *The C language source code for 8515DEMO and 8514TEST, the two 8514/A programs described in the article, can be downloaded using PCTECHline.*

—JS

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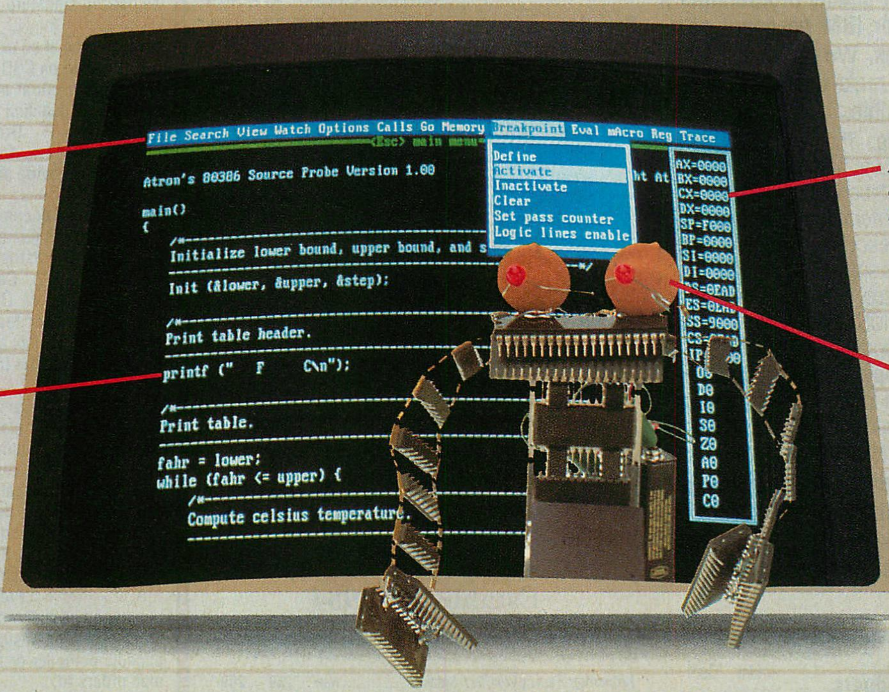

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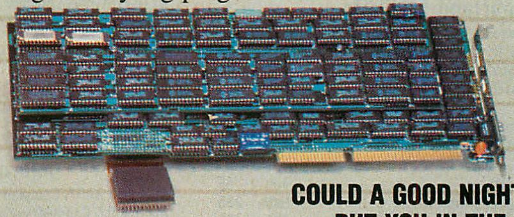

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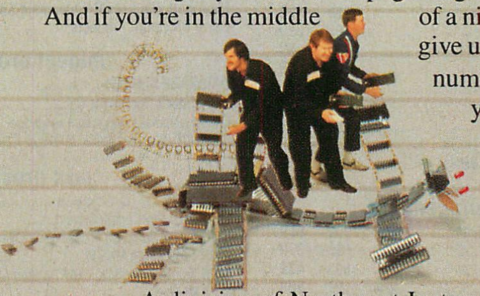

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CIRCLE NO. 203 ON READER SERVICE CARD

NEW DIRECTIONS

IBM and Compaq Strike Again

There's never a dull moment in the 386 market. New machines from the heavy hitters heat up the battle for dominance.

Both IBM and Compaq chose the month of June for their most recent product announcements, but don't look for a wedding (or a honeymoon). The new desktop computers raise the competitive ante by placing both companies on the battlefield for dominance in the 386 market. IBM has bolstered its PS/2 family with better performance and aggressive pricing, and Compaq has added the 386 at both the low and high ends of its lineup.

Not only are the IBM and Compaq announcements important for the respective companies, they are also extremely interesting because they mark shifts in market focus. Deciding which announcement to examine first is difficult, but I'll defer to age and start with IBM, then proceed to the upstart.

As we have said in these pages so often, the PS/2 family has needed a shot in the arm since it was born on April 2, 1987. Exactly 14 months later, IBM provided this much-needed boost in the form of a redesigned Model 50, called the 50 Z, and a series of three, 80386-based desktops, christened the Models 70. In addition, IBM has reduced the prices of three of the Model 80 systems, and one of the Model 60s.

FIXING THE MODEL 50

A year ago, in my article "What IBM Did Right and Wrong, Part/2" (August 1987, p. 46), I complained that the Model 50, with its 10-MHz processor and abysmally slow and small hard disk, was simply no match for the competition in 286 desktops. I objected to the styling of the system unit, based on a consensus that the depth of the chassis would create problems for those with 24-inch work surfaces. However, I said that if the performance issues were addressed, IBM wouldn't be able to build enough Model 50s.

The Model 50 Z directly addresses my complaints except for the styling issue—the updated model has exactly the same footprint and volume as the original. What has changed dramatically is the performance. To begin with, the *Z* stands for zero, as in zero-wait-state memory. Although the 80286 processor clock rate is still the same as in the original Model 50, a 10-MHz, zero-wait-state machine performs about the same as a 12-MHz unit with one wait state. Thus, the Model 50 Z's performance is now directly competitive with the typical 286 box and at least 50 percent greater than its direct ancestor, the PC/AT Model 339.

The second area of performance improvement is even more dramatic. The 50's 20MB hard disk with its sluggish, 85-millisecond (ms) average access time has been replaced with two new drives of 30MB and 60MB capacities. The 30MB drive has an acceptable access time of 39 ms, while the larger, 60MB drive gives a more respectable 27-ms access; both drives have a 1:1 interleave. These drives are the only difference between the two Model 50 Z family members; the 8550-031 includes the 30MB drive with an ST-506 integrated controller (no slot is used), while the 8550-061 has the 60MB drive with an integrated ESDI (enhanced small device interface) controller (again, no slot is used).

In addition, IBM offers the 60MB drive and ESDI controller in an upgrade kit (feature number 6666) that can be used with either the original Model 50 (the 8550-021) or the new -031. The cost of the kit is $1,695, about the same price as third-party vendors have been charging for similar upgrades. (The 50 Z models are available now; the 60MB hard-disk kit debuts in September.)

The Model 50's reengineered system board allows memory to expand to 2MB without using a Micro Channel slot; it replaces the standard 1MB single in-line memory module (SIMM) with IBM's $1,395 2MB SIMM. Also, the Model 50 can use IBM's new PS/2 0-8MB Expanded Memory Adapter/A, which offers up to 8MB in a single Micro Channel slot at a cost of $600 for the empty board and $995 each for 2MB, 85-ns SIMMs. The board supports the Lotus/Intel/Microsoft expanded memory specification 3.2 (groan—why not EMS 4.0 like the rest of the world?) with included drivers and provides either extended or expanded memory.

Pricewise, the 50 Z is competitive. As with all PS/2 models, it includes a built-in VGA, 3.5-inch 1.44MB diskette drive, serial port, parallel port, and mouse port. The 30MB hard disk

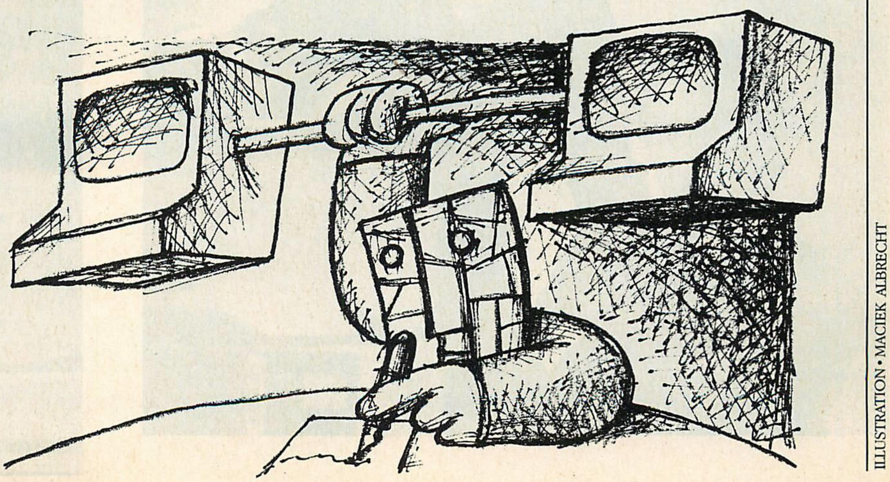


ILLUSTRATION • MACIEK ALBRECHT

Model 50 costs $3,995 ($400 more than the original Model 50), and the 60MB version costs $4,595. In comparison, the AST Premium/286 Model 140 with a 40MB hard disk and AST's EGA is $4,095; the Compaq Deskpro 286, also with 40MB of disk and equipped with Compaq's optional 16-bit VGA (called VGS) now lists at $4,798.

The original Model 50, the -021 model, still is available at its original price. However, with the small difference in the list price, most buyers will quickly opt for the new 50 Z with its better performance and greater capacities. Its small footprint, notwithstanding its depth, is attractive. The removal of the 50's weakest point, the crippled hard disk, will surely turn heads that have been ignoring the machine all along. This makes the 50 Z a critically important machine for IBM because, until now, it has not truly had a replacement for the AT 339.

THE GANG OF THREE

In last August's "Right/Wrong" article, I took IBM to task for being too conservative with its first 386-based machine—the Model 80. I speculated about the rumored Model 70, suggesting the form/factor of a Model 50; my musings in the April issue ("Why the PS/2 Isn't a Success," p. 25) reflect the same thought, with more harsh words about the Model 80.

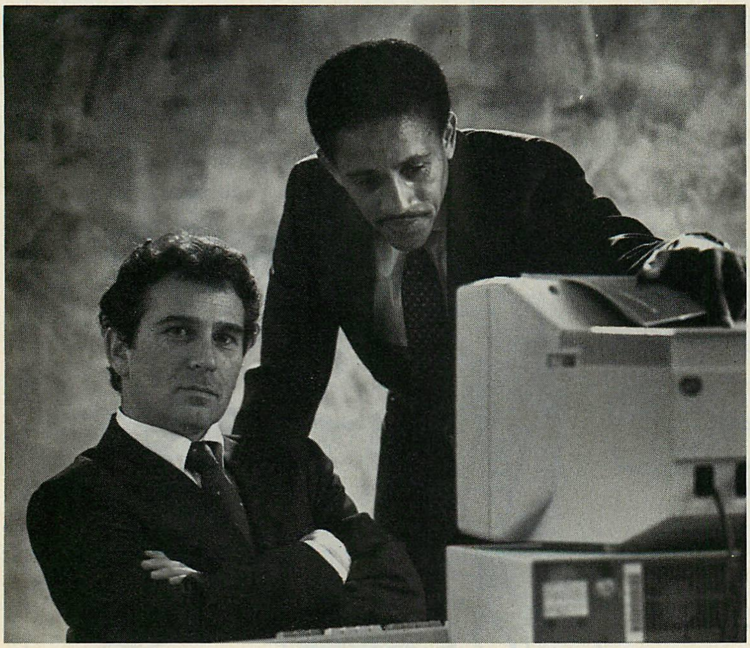
The Model 70 turns out to be more than just a rumor, and its three versions each come in a package exactly the same size as the Model 50. This is a clear indication from IBM that its more powerful desktop machines will share the same compact design.

IBM offers us one Model 70 for each of the currently available 386 clock rates: 16, 20, and 25 MHz. The first two machines, designated the 8570-E61 and -121, have the same architecture and differ only in processor speed, standard memory, and hard-disk capacity. The -E61 is the 16-MHz unit and includes 1MB of memory and a 60MB ESDI hard disk with an access time of 27 ms and a 1:1 interleave. The -121 is the 20-MHz unit and includes 2MB of memory and a 120MB ESDI hard disk with an access time of 23 ms and a 1:1 interleave.

Both units have system boards with three SIMM connectors and therefore can be expanded to a maximum 6MB of memory without using one of the three Micro Channel slots. A new memory board, the PS/2 2-8MB 80386 Memory Expansion Option (feature number 5211) can expand the system to 14MB at the cost of a slot; a second board is required to get to the machine's maximum capacity of 16MB. The 386 memory board costs $1,695 with 2MB of 85-ns memory; IBM's 2MB, 85-ns SIMMs are $1,395 each. These two Model 70s are available now.

The 8570-A21, which is IBM's first foray into the 25-MHz world, actually beat Compaq's announcement of a 25-MHz system by just over two weeks, although the -A21 is not scheduled to ship until the third quarter of this year. This system uses the Intel 82385 cache controller and 64KB of cache memory, as well as additional IBM circuitry that allows the 82385 to address more than 32KB of cache memory.

The -A21 includes 2MB of 80-ns RAM on the system board along with three SIMM connectors, for a total system-board memory capacity of 8MB using IBM's 2MB, 80-ns SIMMs at $1,495 each. The 2-8MB 80386 Memory Expansion Option gets the machine to its 16MB maximum; systems with this board have a mix of 80-ns memory on the system board and 85-ns memory in the channel. The disk is the same 120MB unit used in the 20-MHz model.



The three Micro Channel slots are the same in all three Model 70s. One slot uses the 16-bit connector and includes the video extension. The other two slots are full 32-bit slots. As with all PS/2 family members, each Model 70 includes a built-in VGA, a mouse port, a serial port, a parallel port, and a 3.5-inch, 1.44MB diskette drive.

Pricing for the entire Model 70 line is aggressive. The 16-MHz 70-E61 lists at $5,995. The 20-MHz -121 is $7,995, but keep in mind that this includes 1MB more base RAM and 60MB more hard disk in addition to the 25-percent performance increment. The 25-MHz -A21 is $11,295; the $3,300 jump over the -121 buys only speed in the form of the higher clock rate, slightly faster memory, and the cache controller. If configured with two additional 2MB RAM SIMMs and the 8513 color display, the prices rise to $9,470 for the 5MB -E61, $11,470 for the 6MB -121 (with twice the disk storage of the -E61), and $14,970 for the top-of-the-line 6MB 25-MHz system.

These prices would have created problems in IBM's own product line were it not for price reductions on its three Model 80s. The 16-MHz unit dropped $500, to $7,995. Both 20-MHz models were reduced by $2,000: the -111 model with the 115MB hard disk to $8,995, and the -311 model with the 314MB disk lowered to $11,995.

These prices are all higher than a comparable Model 70, so IBM is saying that the additional Micro Channel slots and the ability to mount two hard disks (the Model 70s can accommodate only one) is worth the extra tariff for the tower units. That is probably true; the towering Model 80s are better suited as LAN servers, for example, than the smaller 70s because of their considerably larger disk capacity (about 600MB compared to the 70's 120MB).

Comparisons to Compaq's 386 line are inevitable. The Deskpro 386 Model 40 with 16-MHz clock, 1MB of RAM, a 40MB hard disk, and the Compaq 16-bit VGS lists for $7,098—$1,000 more than the 70-E61 with its 20MB disk advantage. The Deskpro 386/20 Model 130, with its cache controller, 20-MHz clock rate, 2MB of RAM, a 130MB ESDI hard disk, and the VGS, lists at $10,647—a whopping $2,600 more than the 70-121. *PC Tech Journal*'s tests show that the Compaq's CPU performance is 25 percent faster than the Model 70-121 (as a result of the 82385), and it has a disk performance edge. Compaq's new Deskpro 386/25, configured with 2MB of RAM and the VGS, lists for $11,447; IBM's 70-A21 list price is $11,295. At the high end, at least, Compaq comes closer to IBM's pricing.

You can look at the Compaq comparison in two ways. First, each of the Compaq machines is more expandable than the roughly equivalent Model 70; if expansion is important, then the comparison should be between IBM's Model 80s and the Compaq machines. The Deskpro 386 Model 40 at $7,098 compares favorably with the 16-MHz PS/2 Model 80-041 with its 40MB hard disk at $6,995. The Deskpro 386/20 Model 130's $10,647 price tag is still $1,600 more than the PS/2 Model 80-111; however, Compaq does offer a performance edge.

The other way to think about the comparison is to consider putting desktop computers in front of users who need 386 performance. The typical user, even the typical power user, is not likely to need 300-600MB of hard disk, four more add-in boards, and so on. The real issues are a 386 processor at the desired level of performance, enough hard disk to allow for expansion of local storage, and plenty of room to grow in RAM.

These comparisons are not flawless. Although the Compaq VGS is an extra-cost option that raises the list price of Compaq machines by $600, it also offers significantly higher performance than IBM's built-in VGA. If that is not an issue, then a less expensive VGA can be bought on the open market, sometimes for as little as $300. Absent on the Compaq machines is the mouse port; this requires the addition of either a serial port or bus interface, which raises the cost of the Compaq machines by about $100.

IBM needs the three Model 70s to shore up the top end of the PS/2 family. Compaq has outsold IBM briskly in the 386 category. Compaq's new machines serve only to increase the competition, so IBM had to come up with a better suite of 386 machines than those offered by the Model 80 series.

The Model 70 will be a formidable competitor. Users will appreciate its small footprint and its properly sized, high-performance hard disks. The variety of machines at a range of prices gives IBM opportunities at several levels of the market.

THE BIG PICTURE

What does the introduction of these new PS/2 models mean to the state of the whole PS/2 line? First, the Models 60 and 80 seem to pale in comparison to the new guys. Many buyers undoubtedly chose the Model 60 for its greater disk capacity, but this is no longer an issue. The Model 80 was the only 386 offering from IBM, and Compaq won that battle decisively. IBM lowered the prices of these machines, not only to make the pricing of the Model 70s seem reasonable, but also to make the originals more competitive. IBM is bound to beef up both the 60 and 80 series in the future.

Second, I am disappointed not to see a revised VGA chip in the new machines. The Compaq 16-bit VGS is so dramatically faster than the built-in VGA of the PS/2 family that I was just sure IBM would take early steps not to let this standard slip away. If the performance of the graphics subsystem is an issue, the Compaq solution, and others like it that are now emerging, deserve serious consideration.

The last point I want to make is about memory. IBM improved the memory situation tremendously on both the 50 Z and the 70s by allowing greater expandability on the system board. This method, however, has one hidden cost: on the Model 50 Z, which comes with a single 1MB SIMM, expansion to 2MB on the system board is at the expense of the original memory module; the same is true for the Model 70-E61, which can be expanded to 6MB only if the original SIMM is replaced with a 2MB module.

On the 50 Z, I wish IBM had offered a second model number with 2MB standard; given the advent of OS/2 and even the clamoring of DOS applications for more memory, this strikes me as a more cost-effective solution.

Another memory issue relates to the Model 70s. All 386 machines are notoriously hungry for memory, and expansion memory is in short supply. When I asked how IBM expects to supply its customers with memory under the present circumstances, IBM Entry Systems President William Lowe gave an interesting answer. He said that as much as 90 percent of IBM's memory needs are being met by IBM itself, and he does not anticipate problems with supply. And, Lowe added, IBM would be using its new 8-inch-wafer technology to manufacture 1-Mbit DRAMs (that is what is on the SIMMs)—a move that increases both volume and, according to IBM, yield. In short, IBM is positioning itself as a company that is not subject to the volatility of the worldwide RAM market.

More time will be required to see just how the market responds to the expanded PS/2 line. For the moment, PS/2 looks far, far better than it did.

COMPAQ COMES THROUGH

Following IBM by a little more than two weeks, Compaq announced two new 386-based machines. One is a natural follow-on to the existing line, and one gives Compaq yet another feather in its "we did it first" cap.

The follow-on product is the Deskpro 386/25. It comes in two models, both of which have 1MB of RAM, the Intel 82385 cache controller, an ESDI hard-disk controller, and six empty classic-bus slots. The disk sizes are 110MB and 300MB; the 300MB version of the 386/20 has been discontinued. The price of the system unit for the Model 110 is $10,299, while the Model 300 costs $13,299; configured with the Compaq VGS, the prices are $10,898 and $13,898, respectively.

The biggest difference between the 386/20 and the 386/25, besides the obvious 25-percent increase in performance, is the handling of the math coprocessor options. Both machines support the 80387 chip, but support for

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Dr. Dobb's Journal -- May 1988

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the Weitek coprocessor has changed. The 386/20 requires a full-sized board that plugs into a special socket on the system board. The 386/25 exploits Weitek's recent announcement of a single-chip version of the 1167 chip set; both the 387 and the Weitek processor now occupy side-by-side sockets on the system board.

The new machine uses the same *memory modules* as the 386/20, which gives Compaq an edge over IBM for systems requiring large memory. Compaq's price for its memory modules is $549 for 1MB and $2,099 for 4MB, or $525 per megabyte. The 25-MHz Model 70 2MB SIMMs cost $1,495, or $750 per megabyte. Configuring a machine for 6MB costs the IBM Model 70 owner $2,990 and the 386/25 owner $2,648. A 16MB IBM configuration requires an additional $10,465 for the Model 70 and $9,296 for the 386/25.

PC Tech Journal tests show that the Compaq disk subsystem is faster than that on the PS/2 Model 70-A21. The preliminary results, based on testing with caching *disabled*, show the Compaq machine with a significant advantage. With caching enabled (at the expense of memory), the gap closes, although Compaq is still faster.

Comparing the 386/25 to the PS/2 70-A21 could lead to a decision either way. The IBM system is smaller and more compact. The Compaq system has faster mass storage and a faster VGA. The 386/25 also can have a larger hard disk (300MB) if that is a consideration. Neither machine is ideal for a server because both support only a single hard disk, while systems such as ALR's FlexCache series and even the IBM Model 80s support at least two.

To address this issue, Compaq also announced its 300/600MB Fixed Disk Drive Expansion Unit, an add-on chassis that comes with a 300MB disk drive installed and costs $6,999. The chassis can hold two drives (additional 300MB drives are $6,499); two chassis can be connected, allowing up to a total of 1.2GB of mass storage. The expansion chassis is compatible with any Compaq 32-bit 386 model, which includes the Deskpro 386 Model 40 and all models of the 386/20 and 386/25.

The big edge Compaq has over IBM here is the suitability of the 386/25 for use as a technical workstation. Its greater performance, larger disk, and the extra performance that the Weitek processor can deliver for calculation-intensive applications leave the PS/2 70-A21 panting in the dust.

P9 LIVES!

Where Compaq has really stepped out in front is with the first personal computer to use the much-rumored, "P9" chip, which Intel has formally named the 80386SX. Compaq's new machine is called the Deskpro 386*s*.

As we have all expected for some time, the new chip has the complete, 32-bit 386 architecture, but the external data bus it provides is only 16 bits wide, as compared with the 32-bit bus of the regular 386 processors. The advantage of this scheme is, quite simply, that the complexity and cost of the system board and bus are considerably reduced over a full 386 implementation. Even so, the full power of the 386 instruction set is provided. The bottom line is a chip that really is a 386, but just doesn't run quite as fast.

The 80386SX and its companion 80387SX coprocessor run at a clock rate of 16 MHz. They are specially packaged for manufacturing; the 386SX can be directly surface-mounted, and the 387SX can either be surface-mounted or inserted in a specially designed socket. Both are radically different in their form factor than any previous Intel processor commonly found in desktop computers; the 386SX's plastic package and surface mount leads indicate that Intel was thinking about keeping down the cost of building a system around the chip.

On the outside, Compaq's new 386*s* represents a significant break with tradition; the cases for the system unit and monitor have been restyled and are more attractive than the Darth Vader facade of the Deskpro series. The changes are more than cosmetic. Compaq's trademark keyboard cable tangle is a thing of the past on the 386*s* because the cable plugs into the rear of the system unit (a Compaq first) and the underside of the keyboard. The power switch has moved to the front, which I really appreciate.

The three members of the 386*s* family are the Model 1, with no hard disk; the Model 20, with a 20MB drive (29-ms average access time); and the Model 40, with a 40MB drive (29-ms average access time). Inside, each model includes a 5.25-inch 1.2MB diskette drive, 1MB of memory, one memory expansion slot, four classic-bus expansion slots, a serial port, a parallel port, an "auxiliary input" port (suggested use: a mouse), and Compaq's 16-bit VGS. This is a PS/2-like standard configuration—obviously no accident.

Compaq offers as options for the 386*s* a 3.5-inch 1.44MB diskette drive, 40MB or 135MB tape backup systems, the matching 387SX coprocessor, and memory expansion boards and modules designed specifically for the new machine. Unlike its siblings, the Deskpro 386*s* comes with 1MB of memory on the system board; because of this, the expansion options are actually more flexible than with Compaq's other 386 offerings. The 386*s* can be expanded to a maximum of 13MB.

A 386*s* can have a second hard disk, which can be not only 20MB or 40MB, but also 110MB with an average access time of 25 ms. You could even replace the original hard disk and build a system with two 110MB drives (at $3,499 each).

Compaq says that the 386*s* line delivers a 386 personal computer for the price of an AT. If comparisons are made against competitive 286 machines, however, that argument is shaky. Compaq's prices are $3,799 for the Model 1, $4,499 for the Model 20, and $5,199 for the Model 40. This makes the Model 40 about $1,200 more than the PS/2 50 Z (30MB) and about $400 more than Compaq's own Deskpro 286 Model 40. Our preliminary

testing shows that the 386*s* system is about 20 percent faster than the 50 Z, and the disk performance is about 40 percent better; these performance characteristics may not be enough to offset the price difference.

The comparison between the 386*s* and other 386 machines is not clear cut. While less expensive, the 386*s* cannot measure up to full 32-bit implementations, and its performance is only 20 percent better than a 286. Fitting the 386*s* into a niche is difficult.

This does not make the 386*s* a bad idea. The problem is that so few programs are available to exploit the unique capabilities of the 386 processor. Most of the applications we use today must still be written for the lowest common denominator, the 8088. However, those programs that are written to take advantage of the 386 instruction set gain an advantage on *any* 386; this means that a product such as Borland's Paradox 386 on the Compaq 386*s* will show significant performance gains over Paradox 2.0 on a 286-based machine—more than just the difference in clock rate.

This is the promise of any 386; in the future, its power will be tapped, so those already so equipped will have the advantage. In many cases, the performance of the 386 may not matter; just the fact that the machine can run 386 software will be extremely important. For example, the 386*s* will run Microsoft Windows/386, something no 286 machine can do.

Compaq is going after a new market with the 386*s* line. As users and systems developers see more software that takes advantage of the 386 architecture, an increasing number of desktops that might have been happy with a 286 are going to want the 386 capability available for just a bit more money. Until now, the entry point for 386 machines from the major vendors has been high; the 386*s* changes that.

One problem for the 386*s* is the price of the 16-MHz version of the PS/2 Model 70. It is only $800 more than the 40MB 386*s* model, which may be too close for comfort—just another example of IBM's aggressive pricing.

Another complication is the price of memory. Expansion memory for the 386*s* is more expensive than for Compaq's 386/20 or /25 systems. Adding the first 4MB of memory to the 386*s* costs $2,699; adding it to either the /20 or /25 costs $2,099, and adding it to the original 16-MHz Deskpro 386 costs $1,999. At any larger memory size, the 386*s* memory is more expensive.

Nonetheless, Compaq is first again with an important new processor, which can only add to its prestige and reputation. The company is stepping off in a new market direction with a new styling and a new processor. Many buyers are sure to find the 386*s* to have just the right size, performance, and price to meet their needs. We can expect more from Compaq along these lines in the future as it works ever harder to retain its prized position as the 386 market leader.

No matter what the eventual outcome, the die is now cast for an intriguing market battle between the two largest personal computer manufacturers. IBM will be struggling to increase its market share, while Compaq moves to continue its upward rise.

We all will be watching very carefully.

Will Fastie is editorial director and founding editor of PC Tech Journal.

Enjoy a big Mac without eating anything.

What's this stack of DOS software doing next to a Macintosh® II? Waiting to be thrown out, right?

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CIRCLE NO. 135 ON READER SERVICE CARD

TECH RELEASES

The latest in hardware, software, and technology for systems developers and integrators

IBM PS/2 Model 70 386

SYSTEMS

IBM Corporation has expanded its PS/2 family of computers with seven desktop machines. The **Model 70 386** is available in three configurations. The **Model 70-A21** features a 25-MHz 80386, an 82385 memory cache controller, a 64KB memory cache operating at zero wait states, 2MB of 80-ns RAM (expandable to 8MB), and a 23-ms 120MB hard-disk drive. The **Model 70-121** has a 20-MHz 386 with zero to two wait states, 2MB of 85-ns RAM (expandable to 6MB), and a 120MB hard-disk drive. The **Model 70-E61** has a 16-MHz 386 with zero to two wait states, 1MB of 100-ns RAM (expandable to 6MB), and a 27-ms 60MB hard-disk drive. All configurations include a 128KB ROM containing power-on self test (POST) of system components, a 1.44MB 3.5-inch diskette drive, an integrated controller, VGA, Micro Channel Architecture, serial and parallel ports, and three slots (one 16-bit, two 32-bit). Model 70-A21, $11,295; Model 70-121, $7,995; Model 70-E61, $5,995.

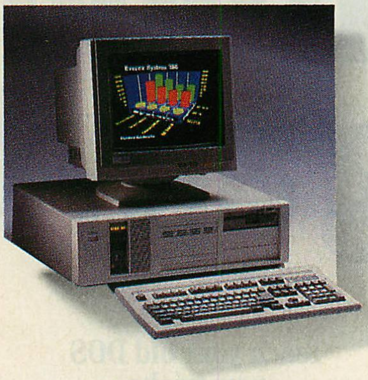
Two configurations of the 10-MHz, zero-wait-state PS/2 **Model 50 Z** have 1MB of 85-ns RAM (expandable to 2MB), 128KB ROM containing POST, 1.44MB 3.5-inch diskette drive, VGA, three 16-bit general-purpose slots, and integrated controllers. **Model 50-031**, with a 39-ms 30MB hard-disk drive, $3995; **Model 50-061**, with a 27-ms 60MB hard-disk drive, $4,595.

The PS/2 **Model 25** is a low-priced workstation containing a preconfigured Token-Ring Network PC adapter. It features a zero-wait-state, 8-MHz 8086 and a choice of monochrome or color display versions. Standard features include 640KB of parity-checked RAM on the system board, a 720KB 3.5-inch diskette drive; 64KB ROM containing POST, MCGA, serial and parallel ports, IBM enhanced keyboard, pointing-device port, and audio connector. Model 25-L01 (monochrome), $2,139; Model 25-L04 (color), $2,848.

IBM Corporation, 900 King Street, Rye Brook, NY 10573; 800/426-2468; for nearest dealer, 800/447-4600

CIRCLE 316 ON READER SERVICE CARD

A PC capable of 5 million instructions per second, the **Step 386/20** from **Everex Systems** incorporates Advanced Memory Management Architecture (AMMA), a proprietary technology that provides a sophisticated memory-caching scheme known as write-back caching. The cache size can be scaled, allowing it to increase according to the amount of main memory being used. Standard features include a 20-MHz Intel 80386, 1MB of RAM (expandable to 16MB) with zero-wait-state operation, a 1:1 interleave diskette/hard-disk drive controller, a 101-key enhanced keyboard, front access to five storage devices, and support for both the Intel 80387 and Weitek 1167. $4,399.



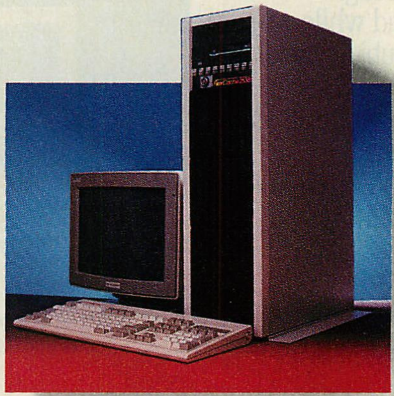
Everex Systems' Step 386/20

Everex Systems, 48431 Milmont Drive, Fremont, CA 94538; 800/356-4283

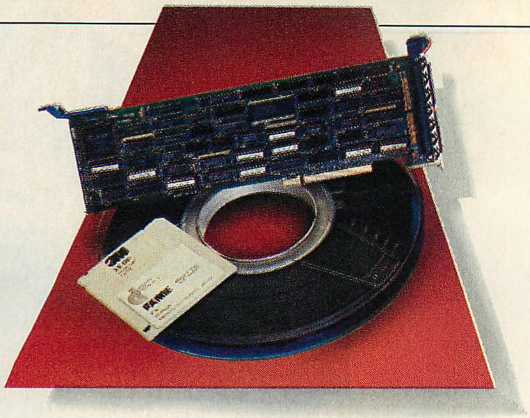
CIRCLE 301 ON READER SERVICE CARD

A 25-MHz 80386-based microcomputer, the **ALR FlexCache 25386,** from **Advanced Logic Research** (ALR) features an ALR-proprietary extended-emulation 82385 cache system. It includes 64KB of 25-ns static RAM caching memory between the CPU and main memory; DMA caching of RAM I/O; byte, word, or double-word caching; posted write-through on all accesses including bytes; and background refresh cycles. The 60-ns RAM chips are designed parallel to the cache system, resulting in zero wait states. Standard features include 1MB of RAM (expandable to 14MB), one 1.2MB 5.25-inch diskette drive, a 150MB ESDI hard-disk drive, and one parallel and one serial port. $9,499; with 300MB ESDI hard-disk drive, $12,499.

Also available from ALR is the **FlexNode 286/386** workstation, which accommodates either a 20-MHz 80286 or 80386 on a CPU card. Both configurations have a zero-wait-state, paged interleave memory architecture. The FlexNode unit has a four-slot backplane that allows the choice of a 286 or 386 configuration. Both models come with a 3.5-inch 1.44MB diskette drive, serial and diskette controller on the backplane, an optional 30MB or 50MB hard-disk drive and controller, and an enhanced keyboard. FlexNode 286, with 512KB of RAM (expandable to 5MB) and 80287 support, $1,990 to



FlexCache 25386 from Advanced Logic Research



FAME controller from Innovative Data Technology

INTERSECT interface kit from NEC

$2,990; FlexNode 386, with 1MB of 32-bit RAM (expandable to 13MB) and 80387 support, $3,490 to $4,449.
Advanced Logic Research, 10 Chrysler, Irvine, CA 92718; 714/581-6770
CIRCLE 302 ON READER SERVICE CARD

Zenith Data Systems (ZDS) has introduced a family of 386- and 286-based battery-operated portable microcomputers that support zero-wait-state operation. The 12-MHz **TurbosPort 386** comes with a 1.44MB 3.5-inch diskette drive, a 28-ms 40MB hard-disk drive with 1:1 interleaving, a 16-bit video interface, 2MB of memory (expandable to

TurbosPort 386 from Zenith Data Systems

3MB), ZDS's Page White display with a 20:1 contrast ratio, a nicad battery that charges in two hours, and a briefcase design with detachable keyboard. $7,999; with internal 2400-bps modem containing Hayes AutoSync, $8,499.

The 12-MHz **SupersPort 286** features a 28-ms 20MB or 40MB hard-disk drive; a 1.44MB 3.5-inch diskette drive; 1MB of RAM (expandable to 2MB); an enhanced backlit, supertwist LCD screen; an external 5.25-inch diskette-drive port; and briefcase design. 20MB version, $4,999; 40MB version, $5,599.

ZDS's **SupersPort** is an 8- or 4.77-MHz 80C88-based portable featuring the same cabinet and expandability as the SupersPort 286. It has 640KB of RAM (expandable to 1.64MB) and is available with a dual 720KB 3.5-inch diskette drive. An optional 20MB hard-disk drive can take the place of the second 720KB diskette drive. $2,399; with 20MB hard-disk drive, $3,599.
Zenith Data Systems, 1000 Milwaukee Avenue, Glenview, IL 60025; 800/842-9000, ext. 1
CIRCLE 303 ON READER SERVICE CARD

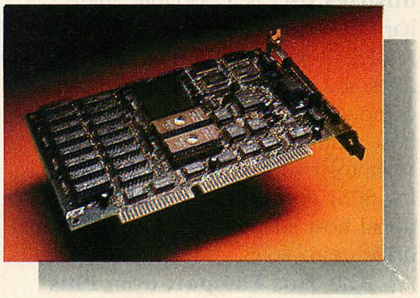
PERIPHERALS

NEC Home Electronics (U.S.A.) Inc. has announced its entrance into the CD ROM market with its **INTERSECT** CD ROM readers: the external Model **CDR-77** and the internal 5.25-inch, half-height Model **CDR-80**. Four available **interface kits** provide compatibility with IBM PC, PC/XT, and PC/AT, and compatibles, PS/2 models, NEC Multi-Speed laptop computers, and SCSI-equipped Macintosh computers. Each kit provides device drivers, and the PC kits include a SCSI interface board. NEC CD ROM readers are bundled with Microsoft's CD ROM Extensions, which allow DOS to recognize CD ROM readers as drives. CDR-77, $999; CDR-80, $899; interface kits, $199 each.

NEC also introduced two CD ROM disks full of graphics images: **Clip Art 3-D**, with several thousand images and fonts, and **Image Folio**, with more than 4,000 photographic-quality video images. $399 each.
NEC Home Electronics (U.S.A.) Inc., 1255 Michael Drive, Wood Dale, IL 60191; 800/632-7638; 312/860-9500
CIRCLE 312 ON READER SERVICE CARD

Innovative Data Technology (IDT) has produced a .5-inch, 9-track tape controller for the PS/2 family of computers. The **FAME** controller offers data-transfer rates of up to 2MB/sec, ASCII-to-EBCDIC and user-programmable code conversion, and an external connector. IDT also supplies a complete DOS software package that includes a system setup/installation program, DOS and I/O device drivers, diagnostics, and data-transfer utilities. Complete subsystem with tape drive, FAME controller, cables, and software, from $4,295; FAME alone, $1,195.
Innovative Data Technology, 5340 Eastgate Mall, San Diego, CA 92121; 619/587-0555
CIRCLE 323 ON READER SERVICE CARD

A high-speed 16-bit graphics adapter is offered by **AST Research Inc.** The **AST VGA Plus** is compatible with either 8- or 16-bit buses. It provides several resolution modes: 720-by-480 pixels with 256 simultaneous colors, 800-by-600 pixels with 16 simultaneous colors, and 720-by-400 pixels in monochrome text with a 9-by-16 character

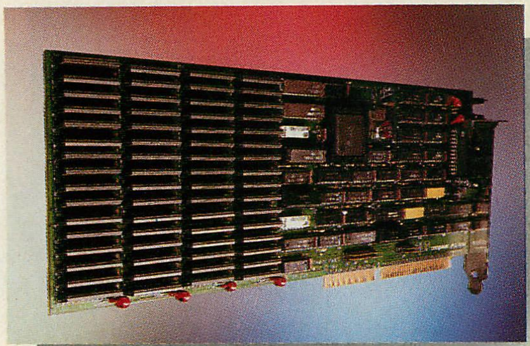


VGA Plus from AST

box for crisp text. Other features include 132-column text display and 256KB of standard on-board graphics memory (expandable to 512KB). $599.

AST also introduced the **AST Premium Display/VGA Color monitor**, which provides up to 720-by-480 pixel resolution on a 14-inch noninterlaced screen. $695.
AST Research Inc., 2121 Alton Avenue, Irvine, CA 92714; 714/863-9991
CIRCLE 315 ON READER SERVICE CARD

Practical Office Systems Inc. has announced an add-on disk controller to migrate data between 5.25- and 3.5-inch



VIVA 2000 color graphics adapter from QDP

Plus Passport hard-disk drive from Plus Development Corp.

diskettes. The **PCT-MF20** controller, along with the **PMD:720/1440** diskette drive, can coexist with the currently installed diskette-drive controllers in IBM PC, PC/XT, PC/AT, and compatibles. It supports the 360KB and 720KB (double-density) and the 1.2MB and 1.44MB (high-density) formats in XTs and compatibles, and it provides compatibility with IBM PS/2 and laptop computer data diskettes. With diskette drive, external version, $489; internal version, $379.
Practical Computer Technologies Inc., 3972 Walnut Street, Fairfax, VA 22030; 703/385-3332
CIRCLE 317 ON READER SERVICE CARD

Three companies have introduced portable, removable hard-disk drives. The **Plato HARDPAC 20** from **Aristotle Industries Inc.** is a portable 20MB hard-disk drive that comes in two models—one for IBM PCs and compatibles and one for Apple Macintosh computers. The PC version requires a host adapter card; the self-contained Macintosh version connects to an existing SCSI port on the Mac. $785; additional host adapter kits, $95; additional drive units, $695.

The **Plus Passport** from **Plus Development Corporation** is a removable 20MB or 40MB 3.5-inch hard-disk drive that offers complete compatibility and data interchange with IBM PC, PC/XT, PC/AT, and PS/2 and compatibility with DOS and OS/2. It employs a 1:1 interleave factor, Hyperwrite for faster disk writing, and a read-ahead buffer to speed data retrieval. The self-contained system fits in a 5.25-inch half-height bay; an optional external chassis is available. $1,250 to $1,550.

Tandon Computer Corporation, which has been incorporating its **Personal Data Pac** into its own systems, has announced the **Tandon Ad-PAC**. The Ad-PAC is a receptacle that allows other Tandon systems or the IBM PC/XT, PC/AT, or compatibles to access the Personal Data Pac as if it were another hard disk in the host computer. Ad-PAC Model 1 (includes a Data Pac receptacle, cabling, and an 8- or 16-bit controller that supports two Ad-PAC receptacles), $599. Model 2 (includes a second Ad-PAC receptacle and cable adapter), $499. Personal Data Pac, $399.

Tandon Ad-PAC removable hard-disk drive

Aristotle Industries Inc., 200-6975 18th Avenue, Burnaby, British Columbia, Canada V3N 4L1; 800/663-8737; 604/522-9880
CIRCLE 319 ON READER SERVICE CARD
Plus Development Corporation, 1778 McCarthy Blvd., Milpitas, CA 95035-7421; 800/826-8022; 408/434-6900
CIRCLE 320 ON READER SERVICE CARD
Tandon Computer Corporation, 405 Science Drive, Moorpark, CA 93021; 800/556-1234; 805/523-0340
CIRCLE 321 ON READER SERVICE CARD

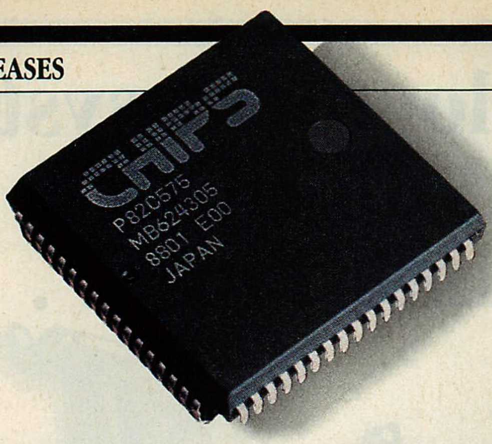
A color graphics display adapter capable of providing 2,048-by-2,048 pixel virtual-screen resolution and 1,280-by-1,024 pixel display resolution is shipping from **QDP Computer Systems Inc.** The **VIVA 2000** implements true hardware windowing for faster operation, allowing the user to resize or relocate a window anywhere on the screen area. Features include hardware pan and zoom, PanFreeze (for digitizer users), user-selectable cursors and colors, pop-up menus, and 2KB-by-2KB virtual-screen frame buffer with real-time panning. Prices start at $2,200.
QDP Computer Systems Inc., 23632 Mercantile Road, Beachwood, OH 44122; 216/464-3183
CIRCLE 313 ON READER SERVICE CARD

CONNECTIONS

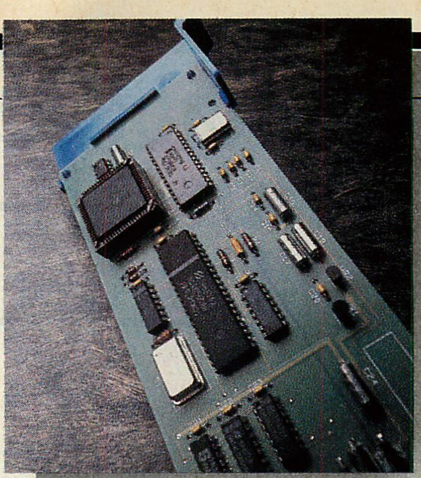
PCMAINFRAME 3.0, an intelligent micro-mainframe link, is available from **cfSOFTWARE Inc.** Its enhanced features include Dialog, a scripting facility that allows terminal emulation, conditional logic, and automated operation of all 3270 functions. Added device support includes IBM SDLC LAN Gateway. Price (including 10 PC licenses and first-year maintenance) for DOS/VSE sites, $7,500; for MVS sites, $10,000.
cfSOFTWARE Inc., 2454 E. Dempster, Suite 201, Des Plaines, IL 60016; 800/234-9884; 312/824-7180
CIRCLE 311 ON READER SERVICE CARD

The **Fiber Bus Transceiver** (FBT) from **Versitron** allows Ethernet LANs to use fiber-optic cable—the cabling of choice for better security, range, and reliability. FBT is compatible with Ethernet controllers and software from 3Com, Novell, and Western Digital. Packaged on a half-slot expansion board, FBT uses a clock-recovery and data-regeneration scheme that handles collision detection and allows network nodes to be added without jitter between nodes. Less than $800 per node.
Versitron, 9005 Junction Drive, Annapolis Junction, MD 20701; 301/497-8600
CIRCLE 309 ON READER SERVICE CARD

SunRiver Corporation has introduced the **Cygna 386**, a fiber-optic station for use with 80386-based computers. Cygna 386 provides fully bit-mapped EGA,



82C575 Micro Channel controller from Chips and Technologies



Intel's Hayes-compatible 2400B Modem 2

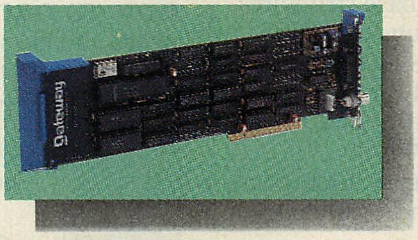
CGA, and Hercules-compatible graphics capabilities at 32 Mbps, as well as full DOS compatibility under UNIX and XENIX. Four Cygna 386 stations can be attached to the **CygnAdapter**, a half-size fiber-optic adapter board placed in the host machine. A 386 AT-bus machine supports 2 to 16 users, and a 32-bit internal bus supports 8 to 32 users. Cygna 386 (CGA version), $1,599; four-port CygnAdapter, $799.
SunRiver Corporation, P.O. Box 9367, Jackson, MS 39206; 601/957-0100
CIRCLE 307 ON READER SERVICE CARD

Internal 2,400-bps modems for the IBM PS/2 have been announced by both **Hayes Microcomputer Products Inc.** and **Intel Corporation**. The **Smartmodem 2400P** from Hayes can be installed in any Micro Channel expansion slot and supports the eight communication ports for the IBM PS/2 Models 50, 60, and 80. The modem also includes a FIFO (first in, first out) data buffer that can be enabled to prevent data loss when the multitasking OS/2 is busy performing other functions. $549.

The Hayes-compatible **Intel 2400B Modem 2**, which is based on Intel's 2,400-bps modem chip set, supports major communications standards such as CCITT V.22, V.22*bis* and Bell 103, and 212A. It allows operations at 2,400, 1,200, and 300 bps. $445.
Hayes Microcomputer Products Inc., 705 Westech Drive, Norcross, GA 30092; 404/449-8791
CIRCLE 304 ON READER SERVICE CARD
Intel Corporation, PCEO, Mail Stop CO3-07,5200 N.E. Elam Young Parkway, Hillsboro, OR 97124-6497; 800/538-3373; 503/629-7357
CIRCLE 305 ON READER SERVICE CARD

A complete hardware/software solution from **AST Research Inc.** provides 3270 terminal emulation capability for PCs and PS/2 computers in remote SNA/SDLC environments. **AST-3270/SNA II** offers up to five display/printer sessions, an IBM-compatible application program interface (API), automatic sign-on capability, keyboard macros, and AST Windows Manager software. $895; upgrade from AST-SNA, $150.
AST Research Inc., 2121 Alton Avenue, Irvine, CA 92714; 714/863-9991; 800/782-9278 (upgrades only)
CIRCLE 308 ON READER SERVICE CARD

A PS/2 Micro Channel version of an Ethernet adapter has been developed by **Gateway Communications Inc.** The **G/Ethernet Micro Channel** implements a communications queuing



G/Ethernet Micro Channel from Gateway

algorithm and 64KB of cache memory, maximizing the rate of data transfer between the network adapter and the CPU and boosting LAN performance. It uses IBM's programmable option select (POS) feature of the PS/2 to configure itself, eliminating the need for DIP switches or jumpers. $525.
Gateway Communications Inc., 2941 Alton Avenue, Irvine, CA 92714; 800/367-6555; 714/553-1555
CIRCLE 306 ON READER SERVICE CARD

TECHNOLOGY

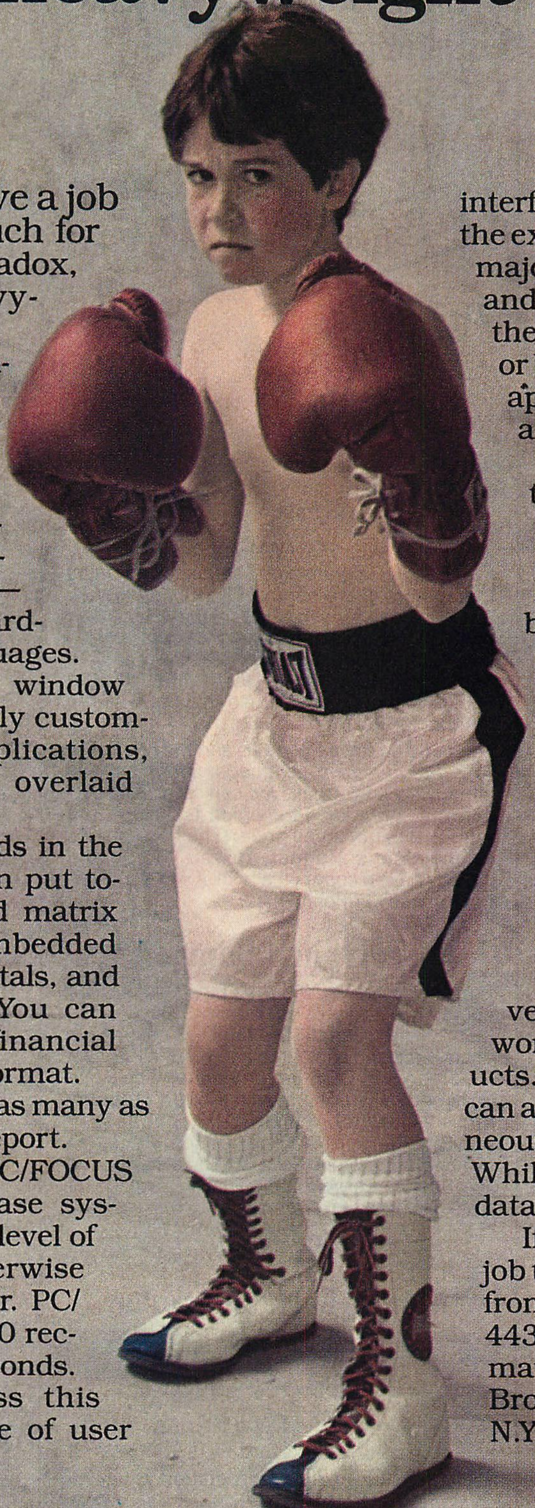
A CMOS single-chip Micro Channel communications interface controller is available from **Chips and Technologies Inc.** The **82C575** is fully compatible with Micro Channel design and supports a wide range of communication applications, including intelligent modems, SDLC/BISYNC/UART adapter cards, and instrumentation. Dual resource allocators with a maximum of 32 I/O address spaces are supported, so that multiple peripherals can be designed on the same expansion card. In quantities of 1,000, $7.20 each.
Chips and Technologies Inc., 3050 Zanker Road, San Jose, CA 95134; 408/434-0600
CIRCLE 324 ON READER SERVICE CARD

DATA MANAGERS

From **Relational Technology Inc.** comes **Release 6** of **INGRES**, its relational data management system that provides scalable performance in multiprocessor environments. The system incorporates a multiserver data manager and provides support for more users and larger databases, as well as fully automated recovery techniques. It includes INGRES TPA (total performance architecture), which results in faster, more productive software over the cycle of database development, operation, and maintenance. Depending on machine class, $5,000 to $160,000.
Relational Technology Inc., 1080 Marina Village Parkway, Alameda, CA 94501-9891; 800/446-4737; 415/769-1400
CIRCLE 330 ON READER SERVICE CARD

A multiuser LAN version of Magic PC, a visual database application-development system, has been introduced by **Aker Corporation. Magic LAN** operates on all LANs supporting the DOS 3.*x* functions. It includes Btrieve/N, a multiuser file manager that allows automatic sharing of data files among multiple users, with file and record locking according to the sharing privileges of each user. Data integrity is provided through a preimaging technique that automatically backs out the last incomplete operation

Can your lightweight database handle a heavyweight challenge?



When you have a job that's too much for dBASE or Paradox, turn to the real heavyweight. PC/FOCUS.

PC/FOCUS is the number one fourth-generation language, with its own powerful database system. It's complete enough to create the complex reports and applications that others can't—without resorting to hard-to-learn procedural languages.

With the PC/FOCUS window painter, you can do highly customized, menu-driven applications, with help screens and overlaid windows.

Using just a few words in the PC/FOCUS 4GL, you can put together highly structured matrix reports that include imbedded data, row and column totals, and customized headings. You can create any standard financial report in your preferred format.

And you can draw on as many as 16 different files for one report.

With the powerful PC/FOCUS shared-relational database system, you can report at a level of detail that would otherwise require a large computer. PC/FOCUS can scan 500,000 records in less than three seconds.

And you can access this power through a choice of user interfaces. A command mode lets the experienced user develop major applications quickly. A point-and-pick windowed interface lets the casual user make a query—or build a substantial application—using only the arrow keys and the enter key.

What's more, any application you develop in the FOCUS language can immediately be run on any of the larger computers supported by FOCUS.

PC/FOCUS includes modules for graphics, statistics, and communications. And there are optional modules including EQL—an English language interface, spreadsheets with goal-seeking capabilities, and interfaces to dBASE and other PC database systems.

There's also a MultiUser version of PC/FOCUS that works with the major LAN products. In a network, up to 32 users can access one database simultaneously without record lockup. While PC/FOCUS maintains your data integrity.

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Bell Labs brought the world UNIX and C, and now professional programmers are discovering AWK. AWK was originally developed for UNIX by Alfred Aho, Richard Weinberger & Brian Kernighan of Bell Labs. Now PolyAWK gives MS-DOS programmers a true implementation of this valuable "new" programming tool. PolyAWK fully conforms to the AWK standard as defined by the original authors in their book, *The AWK Programming Language*.

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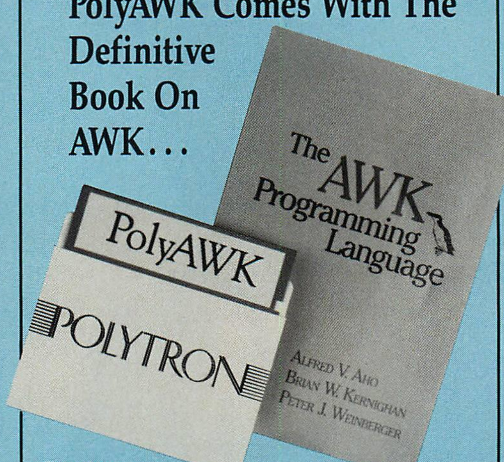
PolyAWK is a powerful pattern matching language for writing short programs to handle common text manipulation and data conversion tasks, multiple input files, dynamic regular expressions, and user-defined functions. A PolyAWK program consists of a sequence of patterns and actions that tell what to look for in the input data and what to do when it's found. PolyAWK searches a set of files for lines matched by any of the patterns. When a matching line is found, the corresponding action is performed. A pattern can select lines by combinations of regular expressions and comparison operations on strings, numbers, fields, variables, and array elements. Actions may perform arbitrary processing on selected lines. The action langauge looks like C, but there are no declarations, and strings and numbers are built-in data types.

Saves You Time & Effort

The most compelling reason to use PolyAWK is that you can literally accomplish in a few lines of code what may take pages in C, Pascal or Assembler. Programmers spend a lot of time writing code to perform simple, mechanical data manipulation — changing the format of data, checking its validity, finding items with some property, adding up numbers and printing reports. It is time consuming to have to write a special-purpose program in a standard language like C or Pascal each time such a task comes up. With PolyAWK, you can handle such tasks with very short programs, often only one or two lines long.

PolyAWK Comes With The Definitive Book On AWK...



Requires MS-DOS 2.0 or above & 256K RAM. **$99**

When you order PolyAWK you receive a copy of *The AWK Programming Language* written by the authors of the original UNIX-based AWK. The book begins with a tutorial that shows how easy AWK is to use, followed by a comprehensive manual. Because PolyAWK is a complete implementation of AWK as defined by the book's authors, you will use this book as the manual for PolyAWK.

You can purchase PolyAWK and the book, *The AWK Programming Language*, for $99. If you already have the book, you can order PolyAWK software only for $85, which is $14 off the regular $99 purchase price. (The book serves as the User's Manual, so you you should already have a copy of the book if you are ordering the software only.)

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The brevity of expression and convenience of operations make PolyAWK valuable for prototyping even large-sized programs. You start with a few lines, then refine the program, experimenting with designs by trying alternatives until you get the desired result. Since programs are short, it's easy to get started and easy to start over when experience suggests a different direction. PolyAWK has even been used for software engineering courses because it's possible to experiment with designs much more readily than with larger languages. It's straightforward to translate a PolyAWK program into another language once the design is right.

Very Concise Code

Where program development time is more important than run time, AWK is hard to beat. These AWK characteristics let you write short and concise programs:

- The implicit input loop and the pattern-action paradigm simplify and often entirely eliminate control flow.
- Field splitting parses the most common forms of input, while numbers and strings and the coercions between them handle the most common data types.
- Associate arrays use ordinary strings as the index in the array and offer an easy way to implement a single-key database.
- Regular expressions are a uniform notation for describing patterns of test.
- Default initialization and the absence of declarations shorten programs.

Large Model Implementation

PolyAWK is a large model implementation and can use all of available memory to run big programs or read files greater than 64K.

Math Support

PolyAWK also includes extensive support for math functions such as strings, integers, floating point numbers and transcendental functions (sin, log, etc.) for scientific applications. Conversion between these types is automatic and always optimized for speed without compromising accuracy.

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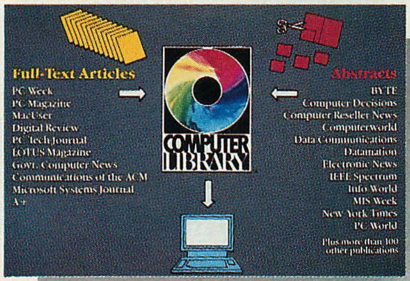
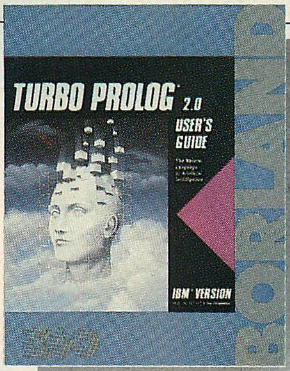


Computer Library from Ziff Communications



Borland's Turbo Prolog 2.0

after power failure. Magic LAN provides a realtime interface to resident interrupt service routines for direct communications with external software drivers via memory. $399.
Aker Corporation, 18007 Skypark, Suite B2, Irvine, CA 92714; 800/345-6244; 714/250-1718
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SOFTWARE DEVELOPMENT

Borland International is offering **Turbo Prolog 2.0**, which includes external database support, an interpreter, a 350-page tutorial, and extensive graphics support. The package's database system comes with a complete set of tools for developing and maintaining large databases on the PC. Turbo Prolog users can upgrade to version 2.0 at no charge. $149.95.
Borland International, 4585 Scotts Valley Drive, Scotts Valley, CA 95066; 800/543-7543; 408/438-8400
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PC Pascal and **PC Fortran**, enhanced programming environments from **Prospero Software Inc.**, contain the Prospero Workbench, a fully integrated working environment that allows programmers to code, compile, debug, test, and document an executable program without interruption. The Workbench includes a four- or eight-window editor, an ISO/ANSI-standard compiler, linker, librarian, runtime libraries, symbolic debugger, and cross referencer. These versions fully implement the international standards and include a PC BIOS library, which allows use of graphics, windows, and other facilities. PC Pascal, $149; PC Fortran, $199.
Prospero Software Inc., 100 Commercial Street, Suite 306, Portland, ME 04101; 800/327-6730; 207/874-0382
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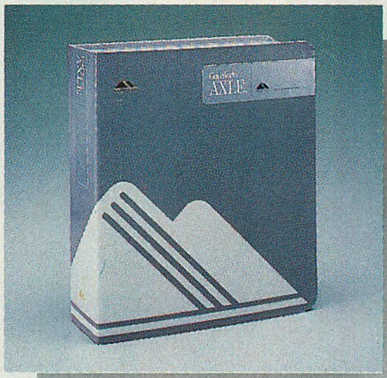
A software package for training AI expert systems developers is being marketed and distributed by **Gold Hill Computers Inc.** under an agreement with **Albathion Software**. **GoldWorks AXLE** uses real-life expert system diagnostic and planning applications as examples, providing full source code.

Package features include the Navigator, an interface that walks new users through the development of an application; Browser, an interface that provides a detailed view of how to build an expert system; Graphics Toolkit, a



GoldWorks AXLE training package from Gold Hill

facility for building object-based graphics interfaces to a GoldWorks knowledge base; and Development Modules, which contain source code for discrete components of the example expert systems (such as simulation, Gantt charts, model editors, and networks). The source code can be integrated with a developer's own application and includes GoldWorks object definitions and LISP code. $1,995.
Gold Hill Computers Inc., 26 Landsdowne Street, Cambridge, MA 02139; 800/242-5477; 617/621-3300
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Modula-OS/2, based on **Logitech Inc.'s** Modula-2 compiler, is designed to take full advantage of OS/2. The software tools in Modula-OS/2 operate in dual mode, simplifying the porting of applications between DOS and OS/2 and allowing the development of applications that run under protected mode, real mode, or both.

Modula-OS/2 includes a real-mode and dual-mode version of the standard Modula-2 3.0 library and utilities that allows the creation of large programs. A set of Foreign Definition Modules enables Modula-2 to access all OS/2 functions, and the POINT editor, with multiple windows and pull-down menu, provides a totally customizable user interface. $349.
Logitech Inc., 6505 Kaiser Drive, Fremont, CA 94555; 415/795-8500
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INFORMATION SYSTEMS

Ziff Communications Company is offering subscriptions to **Computer Library**, a PC-based reference tool delivered monthly on a single CD ROM. Developed in conjunction with **Lotus Development Corporation**, the library consists of the most recent 12 months of ten leading computer-industry journals in full text, including *PC Tech Journal*; the most recent 12 months of computer-related articles from more than 120 computer, communications, electronics, and business periodicals in abstract form; and Lotus's BlueFish search and retrieval software. Introductory price for a one-year subscription, $695; a Sony CD ROM drive is also available, $635.
Ziff Communications Company, One Park Avenue, New York, NY 10016; 212/503-4400
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The material that appears in Tech Releases is based on vendor-supplied information. These products have not been reviewed by the PC Tech Journal *editorial staff.*

The CASE for Structured Development

Software development is an art *and* a science, say proponents of computer-aided systems engineering (CASE). CASE technology is the automation of step-by-step methodologies for software and systems development from step-one planning to ongoing maintenance; it is designed to automate the drudgery of development and free the developer to solve problems.

Long used by mainframe applications developers, CASE technology is catching on among PC developers as companies are faced with backlogs in software development and antiquated systems that need updating, and as PC and local area network (LAN) applications grow more complex.

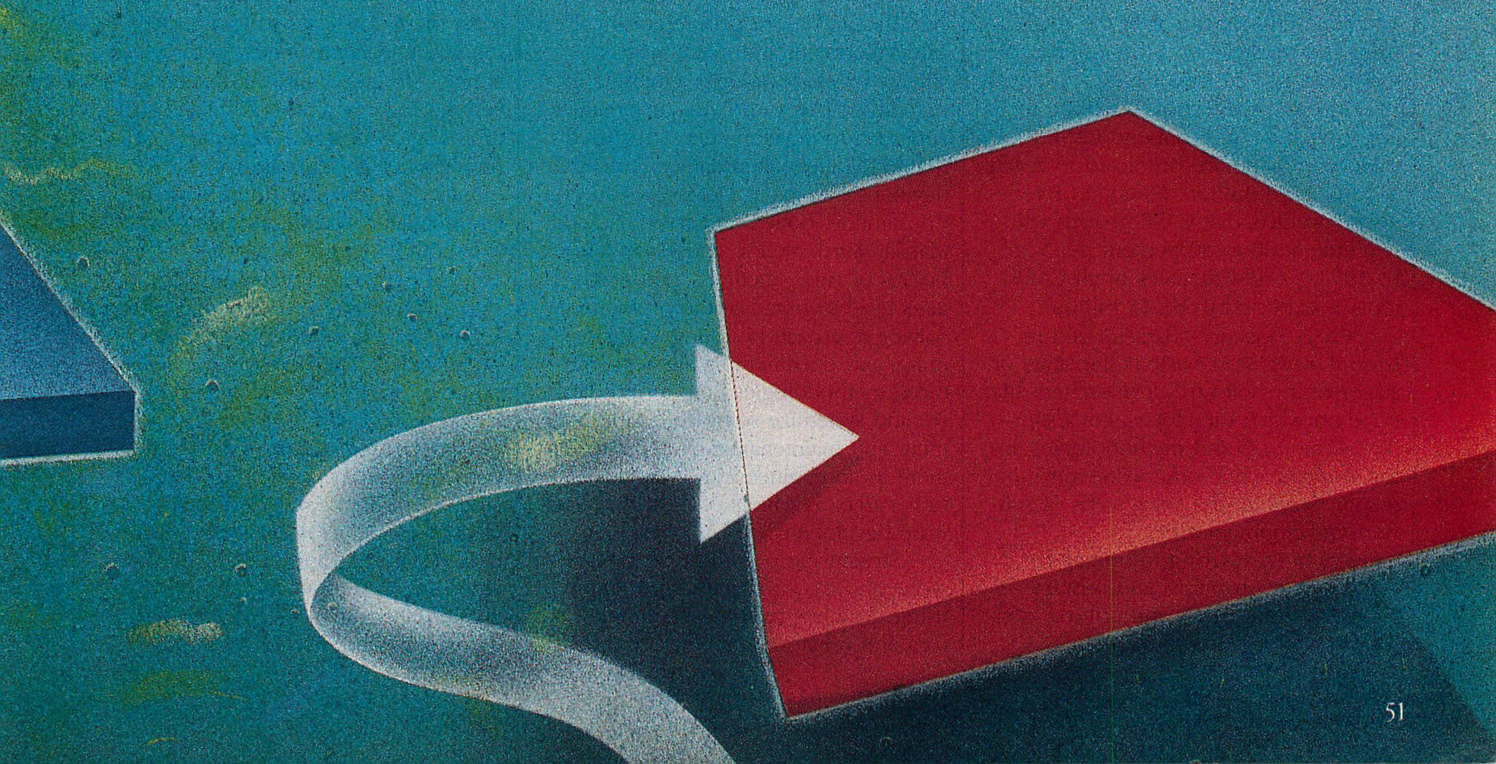
CASE traditionally attracts management first. Faced with fierce competition, the need for faster and better production, and expanded computer services, many managers view CASE as a key to productivity and success in exploiting marketing opportunities. Using CASE to develop reusable modules can reduce the amount of repetitive work the developer needs to do from application to application. CASE tools—the actual software that implement the technology—also provide a clear documentation trail to ease maintenance (a costly and time-consuming problem for most companies) and aid coordination of team development efforts.

Numerous CASE tools are currently on the market (see sidebar). Their emergence has brought excitement and hope but also confusion, especially for PC software developers who have never used CASE tools before. To focus on CASE technology in

No one ever said systems development was easy. But with CASE technology and tools, PC developers can get help managing the software life cycle.

CARMA MCCLURE

ILLUSTRATION • GREG FITZHUGH



the PC environment and to clarify who can benefit from it and how to differentiate among CASE tools, *PC Tech Journal* will review some leading CASE products, beginning this issue with Index Technology's Excelerator (p. 70). Excelerator is one of the most widely used CASE packages on the market.

CASING THE MARKET

CASE tools have one of the highest growth rates of any segment of the computer industry. Extended Intelligence Inc. in Chicago, Illinois, which has done extensive research on the CASE tools market, found that in 1984, the market (mainly PC-based, front-end, life-cycle tools) was dominated by a few vendors selling a few hundred products. By 1985, thousands of front-end CASE tools sold, but CASE vendors penetrated less than one-half of one percent of the front-end market (estimated to contain from 600,000 to 700,000 programmer/analysts).

By the end of 1986, this market grew to $50 million with sales of 10,000 products. Many companies began buying multiple copies of tools, in effect adopting CASE technology as their software-productivity strategy. During this upturn, the number of CASE vendors and tools increased considerably; the scope of the market grew to include code generators (back-end tools), which were previously considered fourth-generation tools, and CASE tools for developing realtime/embedded systems emerged.

In 1987, the front-end commercial CASE tools market grew to $80 million in sales worldwide. Over 10,000 copies of front-end CASE tools were sold—penetrating two percent of the total front-end market—and the number of tools sold per customer rose.

In 1988, CASE tools continue to enjoy rapid sales. Front-end CASE tool sales worldwide are predicted to reach $120 to $150 million. Extended Intelligence predicts that CASE growth will continue at 30 to 40 percent per year; by 1992, worldwide sales of all CASE tools is expected to be $1 billion.

CASE tools are characterized in several ways. Most basic is the stage or stages of the software development life cycle on which they focus. For example, some tools and methodologies are for *analysis*, while others structure the *design*. Some of the basic steps of software development are:

- Planning—gathering information about user problems and requirements; setting goals and criteria; generating alternative solutions.
- Analysis—determining user needs and system constraints; testing alternative solutions against requirements and constraints, generating a functional specification and a logical model for the best solution.
- Design—detailing the design for a selected solution, including diagrams relating all programs, subroutines, and data flow.
- Implementation—building, testing, installing, and tuning software.
- Maintenance—outlining and implementing plans for continually tuning, correcting, and enhancing systems.

Success with CASE most likely will occur when developers and managers choose tools based on methodologies

> *The structured methodologies used in CASE help to standardize and systemize the software development and maintenance process.*

similar to those already in place within the organization. Many CASE tools are microcomputer-based, use powerful graphics to enhance the user interface, and can be integrated with other CASE and non-CASE tools.

THE METHODOLOGY LINK

In the early days of programming, each program was designed ad hoc by one developer. As applications grew more complex and more people got involved in development and maintenance, *structured methodologies* emerged in the early 1970s to provide an organized approach to development. Structured methodologies, often named after their developers (such as DeMarco, Yourdon, Constantine, Gane and Sarson, Jackson, Martin, Ward, Mellor, and Hatley), are bodies of rules, methods, and postulates used to organize the problem-solving approach by listing, diagramming, and documenting all steps. Structured methodologies help to standardize and systemize software development and maintenance by approaching them as an engineering discipline rather than as whims of individual software developers.

Structuring produces clear, fast-to-write, and easy-to-maintain programs using diagrams to show the flow of data and relationships between individual modules (processes). Diagrams help clarify the thinking of a single person working on a small project and are essential for organizing software components and easing communications among team members working on a large project.

The biggest drawback of structured methodologies—until CASE—has been that their diagramming techniques are manual, slow, and tedious. CASE tools are breathing new life into structured methodologies by providing automated graphics facilities for producing charts and diagrams, screen and report painters, data dictionaries, extensive reporting facilities, analysis and checking tools, documentation generators, and code generators (or links to them).

Three orientations. Each CASE tool supports one or more structured methodologies, which follow the basic system input-process-output model (input data are transformed by a process into output). One way to classify a methodology is by orientation: procedure, data, or information.

Procedure-oriented methodologies view the process as a fundamental part of the system model and thus define it first. These methodologies use data-flow diagrams (see figure 1) to show the flow of data from acquisition through processing to output; tree-structured diagrams to represent hierarchical program structures; procedural logic diagrams to detail program logic; and screen and report layouts to show design of user interfaces.

A data-oriented approach views actual input and output as most important. Data structures are defined and procedural components are derived from them. The data structures are merged to form a single, hierarchical control structure, and the detailed procedural logic is written to fit the structure. Logical design is separate from physical design. This approach uses hierarchical tree-structured diagrams and detailed procedural logic diagrams (for both programs and data).

An information-centered approach starts with a logical data model representing information usage across an organization. The developer analyzes a corporation, its business objectives, and strategic information needs.

A nonhierarchical model shows the organization's basic data entities (individual items, such as employees, customers, or invoices, about which data are stored) and their interrelationships; the developer then builds individual information systems that handle the storage and flow of information

A SAMPLING OF CASE TOOLS

The application of structured methodologies to the systems development cycle is on the rise, at least due in part to automation via CASE tools. The list below is a sampling of CASE vendors and their products (features of the tools offered and methodologies supported are given in parentheses). The list is by no means inclusive—most vendors are releasing new tools constantly. While some of the tools listed here run only on mainframes and minis, many are currently available on the PC. In addition, most of them will run on the PC within the next few months.

ANALYSIS/DESIGN TOOLKITS

ASYST Technologies Inc.
800/361-3673; 312/416-2990
The Developer (DeMarco; Yourdon; Martin information engineering; Gane and Sarson)

Cadre Technologies Inc.
401/351-5950
Teamwork SA, RT, IM, SD (DeMarco; Yourdon; Hatley; Ward-Mellor; Chen)

DEFT
416/249-2246
Deft (Gane and Sarson; Yourdon; Jackson; Chen)

Index Technology
617/494-8200
Excelerator, Excelerator/RTS (Gane and Sarson; DeMarco; Chen; MERISE; Bachman; Yourdon; Ward-Mellor; Hatley)

McDonnell-Douglas
314/232-5715
ProKit*WORKBENCH (Gane and Sarson; Yourdon; Chen; Bachman; STRADIS)

Mentor Graphics
800/547-7395; 503/235-7275
Analyst/RT, Designer, Auditor (Yourdon; DeMarco; Hatley; Ward-Mellor)

Nastec Corporation
800/872-8296; 313/353-3300
DesignAid (Gane and Sarson; Yourdon; Chen; Orr; Ward-Mellor)

DATA DESIGN TOOLKITS

Chen and Associates
504/928-5765
SchemaGen, ER-Designer (Chen)

Cullinet Software Inc.
800/551-4555; 617/329-7700
IDMS/ARCHITECT (LSDM; Yourdon; Gane and Sarson; Chen)

MAINTENANCE TOOLKITS

Adpac Corporation
415/974-6699
DFDP, DESIGN, PM/SF (Yourdon; Gane and Sarson; Jackson; Orr)

Language Technology Inc.
800/RECODER; 617/741-1507
Inspector, Recoder (COBOL programs)

Viasoft Inc.
602/952-0050
VIA Insight (COBOL programs)

FRAMEWORK TOOLKITS

AGS Management Systems
215/265-1550
MULTI/CAM (tool integrator; project-management toolkit)

American Management Systems Inc.
703/841-6000
Life-cycle Productivity System (tool integrator; planning toolkit; design toolkit; project-management toolkit)

Atherton Technology
408/734-9822
Software BackPlane (tool integrator)

CADWARE
617/336-5801
SYLVA Foundry, SYLVA System Developer (design toolkit; DeMarco; Gane and Sarson; Ward-Mellor; Constantine)

IBM
914/686-6322
VM/Software Engineering (tool configuration management)

Rand Information Systems Inc.
415/769-5800
Rand Development Center (tool configuration management)

COBOL CODE GENERATORS

Digital Equipment Corporation
508/493-5111
DECase (COBOL code generator)

Netron Inc.
416/636-8333
NETRON/CAP Development System (COBOL code generator)

Pansophic Systems Inc.
312/572-6000
TELON (PL/1, COBOL code generator)

Sage Software Inc.
301/230-3200
APS Development System (COBOL code generator)

Transform Logic Corporation
602/948-2600
Transform (COBOL code generator)

WORKBENCHES

CGI Systems Inc.
800/PAC-1866; 914/735-5030
PACBASE, PACDESIGN (MERISE; Chen; COBOL code generator)

CORTEX Corporation
617/894-7000
CorVision (information engineering; code generator)

EXSYS Inc.
505/836-6676
EXSYS (information engineering)

KnowledgeWare Inc.
800/338-4130; 404/231-8575
Information Engineering Workbench (Martin information engineering; Gane and Sarson; Yourdon; COBOL code generator)

Manager Software Products Inc.
617/863-5800
MANAGER Family (DeMarco; Gane and Sarson; Jackson; BSP; COBOL application generator)

Meta Systems
313/663-6027
Meta Toolset (DeMarco; information engineering; reverse engineering; structured analysis)

Softlab Inc.
415/957-9175
MAESTRO (DeMarco; Gane and Sarson; Jackson; project-management toolkit)

Texas Instruments Inc.
214/575-4404
Information Engineering Facility (IEF) (Martin information engineering; COBOL code generator)

—Carma McClure

10

Looking at CASE tools? Ask these 10 tough questions before you buy.

1 Can we get all the tools we need?

Most CASE tools handle only isolated parts of the development process. KnowledgeWare's tool set covers the complete lifecycle – from planning to the generation of executable COBOL code.

2 Can we get just the tools we want?

With some CASE tools, you may be required to buy more capabilities than you need. KnowledgeWare's CASE solution is modular with separate tools for planning, analysis, design, and code generation that can work together...or alone.

3 How well are the tools integrated?

Most CASE tool vendors offer tools that aren't well integrated with each other. KnowledgeWare's CASE solution is integrated to allow information to flow naturally from planning through detailed design and system construction. Each tool contributes to a growing body of knowledge stored in the Encyclopedia. As information is updated by one tool, the change and its effects are reflected in all other tools that use that information.

4 How are diagrams stored in the tools?

The real value of diagrams in application development is the *meaning* behind those diagrams. KnowledgeWare tools use artificial intelligence technology to store the meaning of diagrams, not just the graphical representation. The Knowledge Coordinator™ translates your diagrams into Encyclopedia information that can drive the system's construction. And it automatically keeps the diagrams in sync with the Encyclopedia.

5 Will the tools work with our current methodology?

Many CASE tool sets are tied to a specific methodology. KnowledgeWare's tools provide an environment where engineering-like discipline is used to integrate existing approaches. So you can use any of today's popular methodologies, and capitalize on the experience you already have in your shop.

6 Can we introduce the tools at any point in the development cycle?

Some CASE tools require you to follow a rigid development process step by step. Each of KnowledgeWare's CASE tools is tied to the others through a common Encyclopedia. You can start wherever you like and even work backward through much of the tool set.

7 Can the tools help improve system quality?

Some of the tools available today are simply diagramming aids. KnowledgeWare's tools use artificial intelligence technology to provide *real-time* checking of consistency and correctness of diagrams as they are created. This catches errors early in the development process, where they are far less costly to fix.

8 How friendly is the user interface?

The CASE tools you select should communicate ideas as clearly as possible and make it *easy* for users to manipulate and modify these ideas. KnowledgeWare's CASE tools are mouse-driven with pull-down menus. You can view many diagrams and definitions at the same time in multiple windows – and in different colors. You can zoom in and out, nest diagrams, mask out distracting elements, and highlight the path of information through a number of diagrams.

9 Can we exchange data with other software we already have?

Most CASE tools only allow you to import and export information through specific interfaces to other products. But an interface to your particular software may not exist and may not be supported as either product evolves. KnowledgeWare products include a flexible import/export facility that ensures you can exchange information with your existing database management systems, fourth generation languages (4GLs), data dictionaries, etc.

10 Is there a plan for future advances?

KnowledgeWare has been following a master plan since its beginnings in 1979. We will continue to add even more capabilities to our current tool set. More powerful commands, more diagramming techniques, and more user-customizable features. Work is now under way to take full advantage of emerging technology such as IBM's SAA, OS/2, and Presentation Manager. This will lead to even more powerful tools in the future.

A comprehensive CASE solution is as close as your phone.

Naturally there's much more to learn about the extensive capabilities of KnowledgeWare's CASE tool set. For more detailed information, **call 1-800-338-4130 toll-free** (in Georgia, call 404/231-8575). And if you want to talk to one of our representatives, just ask when you call. KnowledgeWare, Inc. 3340 Peachtree Rd. N.E., Suite 1100, Atlanta, Georgia 30026.

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The World's Most Comprehensive CASE Tool Set™

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within the organization. As in the data-centered approach, procedures follow from data.

Software versus information engineering. DeMarco Structured Analysis, Gane and Sarson Structured Analysis, and Yourdon Structured Design methodologies are part of the *software engineering* school that starts with a general view of a system and then decomposes each function until all subfunctions are small enough to be implemented into program code (see figure 2). Logical program design is separate from physical design. Software engineering supports data-flow, tree-structured, and procedural logic diagrams as well as screen and report layouts.

Information engineering, a relatively new information-centered development approach, deals with development of full-scale systems (organized collections of entities such as people, procedures, data, hardware, and software that interact with each other and their environment to achieve specific goals). This strategy is gaining widespread acceptance because it uses data modeling (which shows functional dependencies and associations among data items) and strategic planning (which draws a hierarchical model of a corporation and determines what information is needed to accomplish corporate objectives).

Information engineering (see figure 3) begins at a higher level (with strategic planning) than software engineering. At the program-design phase, its approach is similar, but unlike software engineering it cannot support realtime systems.

Information engineering focuses on a logical view of how the organization and system use data and emphasizes business requirements over software system requirements. It is designed to develop database systems and can work with nonhierarchical data structures. Information engineering requires logical data modeling and normalization (placing data items in tables or files to eliminate redundancies and allow access via a primary key), so that it produces integrated information systems because each one is built on top of the same logical data model. Diagrams include those showing entity relationships, data structures, hierarchical tree-structured decomposition, data flow/dependency, screen and report layouts, and detailed program logic.

Information versus realtime systems. All structured methodologies can be used to build information systems; some can also be used for realtime systems. Information systems are data-driven, have complex data structures and large volumes of input data, are input-output intensive, and are machine independent. Realtime systems, which control and are controlled by external events, have simple data structures and are machine dependent.

Examples of realtime systems include flight navigation, communication networks, manufacturing process control, and chemical processing. In each one, the system must respond to external events (such as signals, triggers, or enable/disable) in a timely manner. A realtime system receiving an input signal performs certain calculations and logic and responds to the event by producing output.

Realtime systems must address interrupt handling, intertask communication and synchronization, concurrent processing, response timing to external events, hardware system requirements and constraints, system/environment interactions, and continuous or discrete data. They must be able to represent processes that can be interrupted by external events and run concurrently on multiple computers.

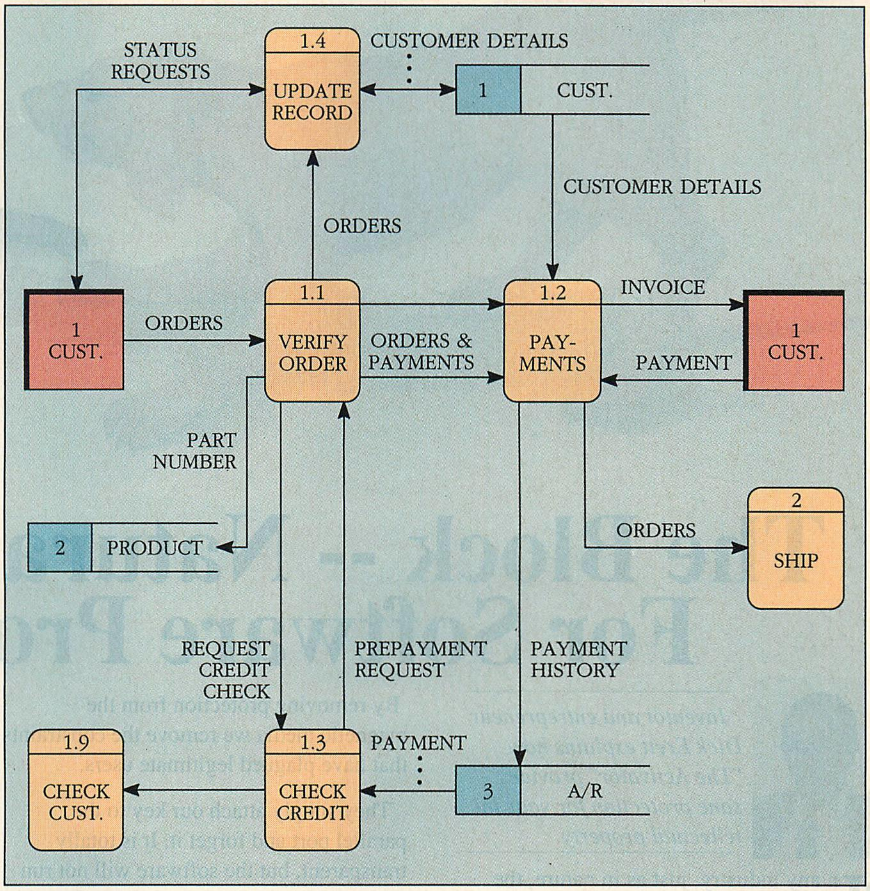
Most analysis and design methodologies and diagrams that support realtime systems are variations of those used to describe information systems. For example, the control-flow diagram (which shows system processes, data I/O signals passed between processes, and process-timing relationships) is a data-flow diagram augmented to include control flow and data flow.

POPULAR METHODOLOGIES

Of all structured methodologies, software developers use DeMarco, Gane and Sarson, and Yourdon for most applications development in the United States. Other methodologies include Jackson, Martin, and Data Structured Systems Development.

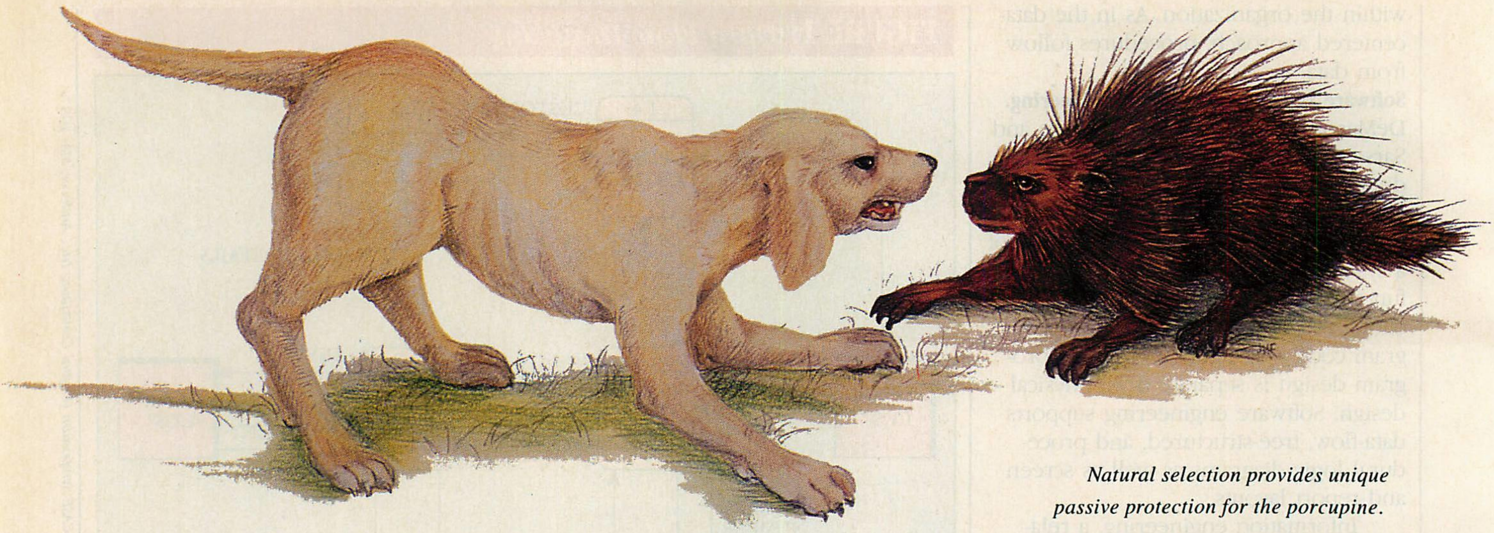
All these structured methodologies (see table 1) follow the top-down approach to reasoning, in which broad (high-level) systems decisions are made first, and more detailed (low-level) de-

FIGURE 1: *Data-Flow Diagram*



A data-flow diagram traces the flow of data through a system. Data stores are indicated by open-end rectangles, processes by boxes with rounded corners, data flow by arrows, and external entities by squares. This diagram was produced by Excelerator from Index Technology Corp., using the Gane and Sarson technique.

Figures 1, 2, 3, and 5 adapted from the proceedings of the CASE Symposium (Digital Consulting Inc., Andover, MA; 1987)



Natural selection provides unique passive protection for the porcupine.

The Block -- Natural Selection For Software Protection

Inventor and entrepreneur Dick Erett explains how "The Activator" provides sane protection for your intellectual property.

"In any industry, just as in nature, the process of natural selection raises one solution above another. Natural selection is the most elegant of engineers.

In the area of software protection The Block has been selected by the marketplace as the solution that works. Over 500,000 packages are protected by our device.

For the past 4 years our philosophy has been; *'You have the right and obligation to protect your intellectual property.'*

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In allowing end-users unlimited copies of a software package and uninhibited hard disk and LAN operation, The Block has created a new ethic for software protection.

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They simply attach our key to the parallel port and forget it. It is totally transparent, but the software will not run without it.

A New Technology For Software Protection

Our newest model, The Activator, builds on our current patented design, and establishes an unprecedented class of software protection.

We have migrated and enhanced the circuitry of The Block to an ASIC (Application-Specific Integrated Circuit) imbedded in The Activator.

This greatly improves speed and performance, while reducing overall size. Data protection can also be provided.

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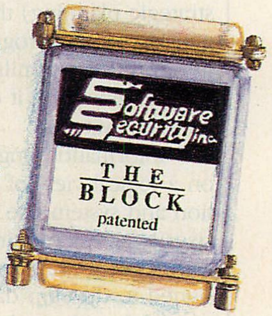
Just as no two snowflakes are the same, no two implementations of The Activator are identical. And like the snowflake the simplicity of The Activator is its greatest beauty.



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cisions are made later. This continuous refinement is called *functional decomposition*, or *explosion*. The resulting diagram (see figure 4) has the input-process-output scheme (context diagram) at the top level; the process then is broken into major subsystems indicated on a separate level or diagram. Each process is refined until the modules can be coded. Conventionally, the number of entities shown on a level will be between five and nine.

Structured analysis. Some methodologies are applied specifically to the analysis phase of software development. The primary purpose of analysis is to produce a system specification that defines the structure of the problem, as the user views it, and system requirements. Advocates of structured analysis suggest that using top-down functional decomposition for both analysis and design produces a system that best meets user needs.

The system specification is composed of data-flow diagrams, a data dictionary, and process specifications. The data-flow diagram is the central modeling tool. The data dictionary is a set of definitions of all data appearing on a data-flow diagram in data stores or as data flows. The definition of a data item consists of individual components and relationships among them:

CUSTOMER FILE = [customer records]
CUSTOMER RECORD = customer-name + customer-address + payment-information + outstanding-orders + customer-type

A process specification, or *minispec*, describes what happens inside a process box in a data-flow diagram. A minispec is usually one page long and explains the transformation of input data into output. It is written in structured English (pseudocode) as a decision table or as an action diagram (which illustrates both an overview of a system's structure and its detailed logic). Each lowest-level process defined has a minispec.

The *DeMarco Methodology* uses functional decomposition, graphics communication, and documentation tools to define system requirements and to link analysis and design. DeMarco defines structured analysis as a seven-step process. Step 1 documents current user procedures and produces physical data-flow diagrams as output. In user terms, the diagrams show locations, personnel, names, and manual and automated procedures.

Step 2 uses data-flow diagrams to create the logical model of the current system. Like the physical model, it is represented as a set of hierarchical data-flow diagrams. The logical model gives an overview of procedures required; the physical model details how these procedures are carried out.

Step 3 takes the logical model for current procedures and incorporates changes for the new system, thus creating a new logical model. It indicates both manual processes and those to be automated and is represented as a set of data-flow diagrams describing the system at varying levels of detail.

Step 4 creates the new physical model for the system by identifying interaction between human and machine. More than one possible model is created to represent varying degrees of automation. In steps 5 and 6, the analyst estimates costs and scheduling for each physical model, then management selects the physical model that best specifies the new system's functions and requirements. The last step packages the structured specification into its final form—a set of data-flow diagrams, a data dictionary, and minispecs.

The *Gane and Sarson Methodology* defines a different version of the structured analysis process. The major difference is that in step 2, Gane and Sarson include data modeling to show functional dependencies and associations among data items. The data stores shown in the data-flow diagrams are defined, possibly in third-normal form, which means that all non-key data items depend completely on the primary key of the record and are independent of each other. In step 3, the logical data model is input for physical database design.

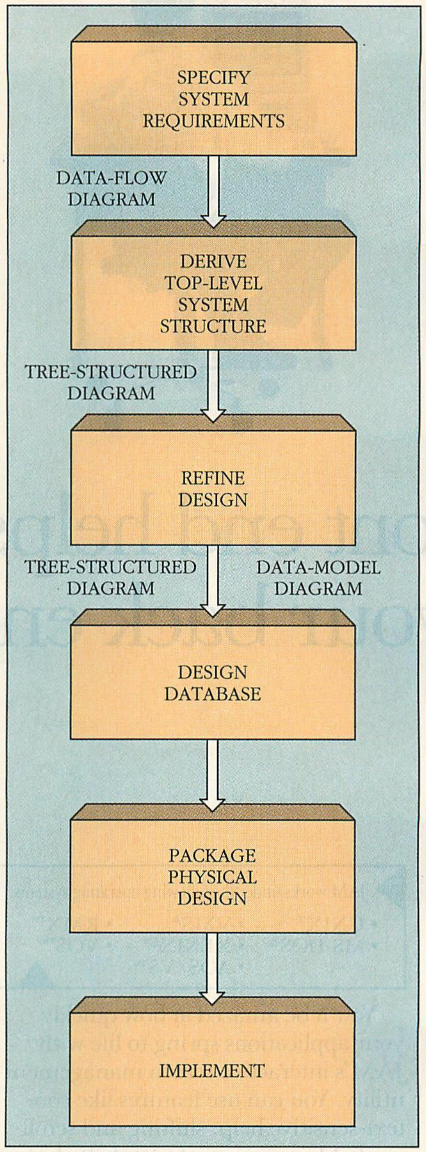
Gane and Sarson also use slightly different graphic symbols in data-flow diagrams that are more suited to computer graphics. Processes are represented as rectangles with rounded corners rather than circles, so linking multiple arrows to the box is easier on the computer. Both the DeMarco and Gane and Sarson techniques fail to provide adequate guidelines for subdividing a problem or checking completeness and correctness of the specification.

Structured design. Once analysis has defined the system specification, design begins. In this stage, the developer plans how a system will be built, what procedure and data components are needed, and how they will be assembled into the final solution. The goal of structured design is to plan all processes and evaluate the entire plan before coding. This strategy is both time- and cost-effective.

The *Yourdon Structured Design Methodology* is the most widely used structured methodology today. This procedure-oriented approach involves steps for documenting the design and measuring and improving design quality. Each step is supported by a set of design strategies, guidelines, and documentation techniques. The Yourdon method does not address issues of data design, only process design.

The principal product of structured design is a *structure chart* (see figure 5), which is a hierarchical tree-structured diagram that defines overall control architecture of a program by showing program procedural compo-

FIGURE 2: *Software Approach*



The steps followed when using a software engineering approach include specifying system requirements, describing a general view of the system and data flows, then decomposing the system to refine the design.

nents and interrelationships. Structure charts are built from boxes representing procedural components and connecting arrows. Data passed between components are called *couples* and are noted next to connecting arrows.

Yourdon, Constantine, and others define structured design as consisting of four basic steps. (Variations and updates to the Yourdon design methodology made by Ward, Mellor, and Hatley support the design of realtime systems.)

The first step is to draw data-flow diagrams to represent the design problem as the flow of data through a system. Processes and the data they operate on are the basis for defining program components.

Two design strategies—*transform analysis* and *transaction analysis*—guide transformation of data-flow diagrams into a structure chart. Transform analysis derives a structure chart from three parts of a data-flow diagram—input (called *afferent branches*), logical processes (called *central transforms*), and output (called *efferent branches*). In transaction analysis, used to design transaction-processing programs, one transaction-center module is identified with several subordinate modules.

The third step in Yourdon Structured Design is to measure quality using coupling and cohesion techniques. Coupling measures the degree of independence between procedural components (modules) in a structure chart. When modules interact very little, they are loosely coupled; when they interact a great deal, they are tightly coupled. A high-quality design means modules are as loosely coupled as possible. Cohesion measures relations among elements within a module; the stronger the cohesion, the better.

The last step, *packaging*, prepares the design for implementation. It divides the logical program design into physical implementation units, which are called *load units*.

The *Jackson Design Methodology* is similar to Yourdon, but is data-oriented so that the structure of data is defined first, then procedural logic. Jackson views a program as a process with inputs and outputs as sequential streams of records. It uses two structured diagramming techniques to describe a program design: the system network diagram shows flow of data from program to program, and the tree-structured diagram represents both program and data structures.

The design process consists of four steps: data, program, operations, and text. The data step of the design process requires drawing a system-network diagram showing all data streams into and out of the program. Each data stream is represented as a hierarchical tree-structured diagram.

The program step combines data structures into one program structure. The designer identifies all correspondence between data-structure components by finding situations in which one input stream produces one output stream and then builds a corresponding skeleton program structure. If the program structure can be reduced into individual data structures, the design is assumed to be correct.

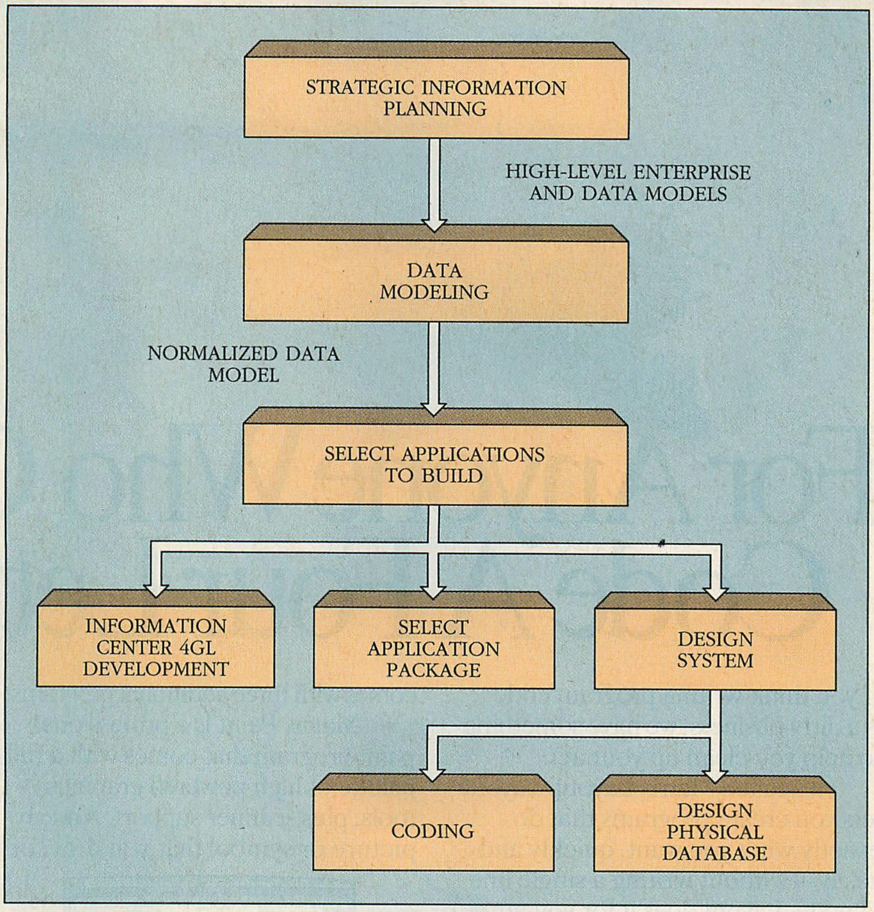
The operations step lists executable operations the program requires to convert input into output, allocates each operation to the appropriate place in the program structure, and verifies correctness by checking that all output is produced and all input is used.

In the text step, the program structure diagram and accompanying operations are translated into structure text (formal pseudocode). Control constructs of sequence, selection, and iteration are written according to strict rules; only informal elementary programming-level instructions are given. Once the structure text includes control conditions governing execution of the select and iteration structures, the program design is ready for implementation. The system-network diagram, data-structure trees, program-structure tree, and structure text form the complete design package.

Providing a more complete design than Yourdon, Jackson considers both data and process to be structures. However, Jackson is weak in adding logic to control iterations and conditionals, and the correctness of these cannot be verified. It aids design of simple information and realtime systems but does not directly apply to complex programs. A complex program must first be divided into a sequence of simple programs.

Dual methodologies. Some methodologies handle both analysis and design. The goal of the *Martin Information Engineering Methodology* is to manage systems development and interaction through central control of one logical

FIGURE 3: *Information Approach*



Information engineering builds full-scale systems. Steps include strategic planning, logical and physical data modeling, selecting specific applications, and coding.

TABLE 1: ***Popular CASE Methodologies***

	DEMARCO	DSSD[a]	GANE-SARSON	JACKSON	MARTIN	YOURDON
ORIENTATION						
Data	○	●	○	○	●	○
Information	○	○	○	○	●	○
Procedure	●	○	●	○	○	●
SYSTEMS						
Information	●	●	●	●	●	●
Realtime extensions	●	○	●	●	○	●
ENGINEERING						
Information	○	○	○	○	●	○
Software	●	●	●	●	○	●
METHODOLOGY TYPE						
Structured analysis	●	●	●	○	●	○
Structured design	○	●	○	●	●	●

● = Yes ○ = No
[a] Data Structured Systems Development

Structured analysis, design, or information engineering methodologies are procedure-, data-, or information-oriented for information or realtime applications.

data model. The methodology looks across all systems in an organization to identify how information is used and shared and how it can be united.

The diagrams used are entity-relationship diagrams (showing relationships among elements in a system and the nature of the relationships), data-structure diagrams, hierarchical tree-structured decomposition diagrams, data-flow diagrams, screen and report layouts, and action diagrams.

The Martin approach has four major steps. First, it creates a strategic plan for business systems, defining business goals for the next five to ten years and building high-level models of the enterprise and its data. An enterprise model defines basic business functions (such as sales) and the organizational structure, using a hierarchical tree-structured decomposition diagram and an entity-relationship diagram.

Entities take shape from information gained by interviewing information system users; analyzing and merging individual user views creates a composite model. Reverse-engineering takes an existing system and works back toward the underlying model on which it is based. The model is then a starting point for creating a data model and determining the order in which to develop information systems to meet overall enterprise goals.

Step 2 uses the business functions that were defined in step 1. This phase extracts and develops into a fully normalized data model the part of the entity-relationship diagram dealing with a particular business area—for example, purchasing. It then defines data entities, attributes, and their relationships and builds information systems to support that area. A decomposition diagram representing business functions is decomposed into business-area processes that perform higher-level functions. An entity/process matrix relates data and processes to each other.

Step 3 involves designing procedures needed to perform business processes defined in step 2 and their logical data structures. Like software engineering at the program development level, systems design is represented by data-structure diagrams, screen/report layouts, decomposition diagrams, and action diagrams.

By prototyping the user interface with screen, dialog, report painters, and user input, the developer discovers user requirements and checks validity of prototypes. The final stage constructs the physical system design and implements the program. The completed information system is delivered as both a logical and a physical database, as well as working, documented code using fourth-generation language and CASE tools such as decision-support tools and code generators.

The *Data Structured Systems Development Methodology* (DSSD) is based on mathematical set theory. In normal programming, a set (an ordered collection of objects sharing one or more common characteristics) is denoted by a list of members enclosed in braces. For example, the set of divisions in a factory might be {production, marketing, distribution}. In mathematics, DSSD sets are denoted by a vertical list of members enclosed by a left brace only. The central design tool of the DSSD methodology is the Warnier-Orr diagram, which is composed of nested left-side brace showing data structure and process flow.

DSSD is a methodology for building information systems only. It is data-driven like the Jackson approach. However, the program/system output completely determines data structure, which determines program structure, whereas Jackson merges all input and output data structures to form a single program structure.

The DSSD methodology begins with a project plan, which is developed by linking overall business goals with system objectives and defining expected business results and constraints. Step 2 involves defining user, organizational, and computer requirements and following steps in logical requirements and physical requirements subphases. The developer defines the system's principal outputs.

An entity diagram determines the scope of the system. An assembly-line diagram defines functional processes (such as transformation of a set of inputs to a set of outputs). A Warnier-Orr diagram and a data dictionary show the output needed to support processes and define the logical output base.

The DSSD methodology considers logical and physical design. Using output from the previous phase as input, logical database design develops the data structures that contain minimum data required to produce output. It then develops files representing a normalized data architecture. Data updates and input transactions are defined; update and input bases are developed for later use in guiding physical database design. Warnier-Orr diagrams represent the data structures, the update base, and input base.

The logical process base is developed and represented as a Warnier-Orr diagram to define the mappings needed to produce system output from input. During physical design, physical environment constraints, such as those imposed by a programming language, attach to the logical process base. The methodology then presents steps for building, installing, using, maintaining, and evaluating the system.

A CASE FOR TOOLS

An individual CASE tool automates one small, focused step in the life-cycle process. Individual tools fall into these general categories:

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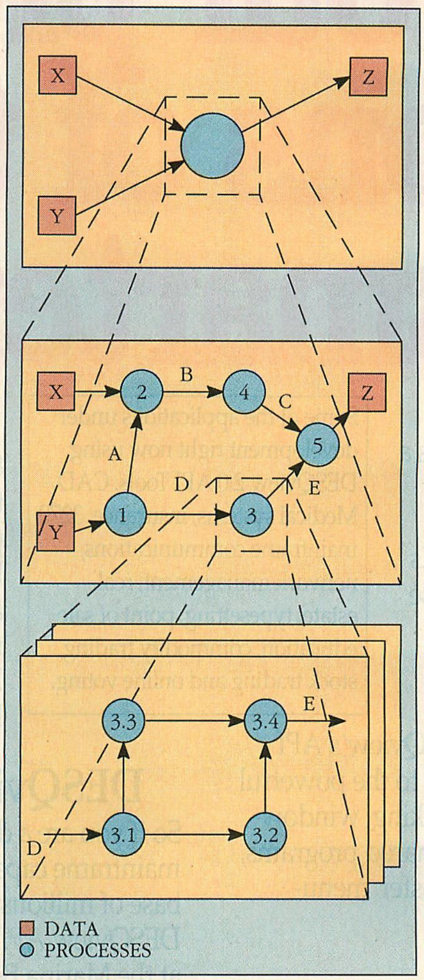
- Specification-checking tools to detect incomplete, syntactically incorrect, and inconsistent system specifications
- Code generators to be able to generate executable code from pictorial system specifications
- Documentation generators to produce technical and user documentation required by structured methodologies.

In the past, a CASE tool automating one step in the life-cycle process often did not work with tools (especially those developed by different vendors) for automating other steps. Today, a tool's ability to integrate is a major consideration for buyers seeking an A-to-Z solution to software development, and standards are emerging for interfacing multivendor CASE tools.

CASE *toolkits* provide integrated tools for developers seeking to automate only one phase of the life-cycle process, while *workbenches* provide integrated tools for automating the entire development process. *Frameworks* integrate CASE tools and/or link them with non-CASE software development tools, and *methodology companions* support a particular structured methodology and automatically guide developers through the development steps.

FIGURE 4: ***Decomposition***



In top-down functional decomposition, the highest level input-process-output scheme (context diagram) is continually refined until modules are small enough to be coded.

Figure 4 adapted from Structured Analysis and Design of Information Systems *by A. Ziya Aktas (Prentice-Hall Inc, Englewood Cliffs, NJ: 1987)*

WELL-EQUIPPED TOOLKITS

Toolkits can focus on the design of realtime, information, or project management systems. They also can be classified by the hardware and operating system on which they run; by the ease with which they can be integrated into a family of compatible CASE tools; by their architecture (open, so that it can be used with products from other vendors, or closed), by the structured methodology or methodologies they support; and by development languages they support (such as Ada, COBOL, FORTRAN, C, and PL/1).

Many CASE toolkits run on an IBM PC or compatible under DOS. Some run on the Apple Macintosh, Wang PC, or Texas Instruments' Professional PC. Others run only on 32-bit workstations such as Sun, Apollo, or Digital Equipment Corporation (DEC) VAXSTATION II; on an IBM or Data General mainframe; or across the DEC VAX family. Many open-architecture products are not limited to one specific hardware, operating system, target programming language, or structured methodology.

Analysis toolkits. By automatically doing burdensome paperwork, taking care of countless system details, and producing a specification describing system requirements, analysis toolkits make it easy to follow the established principles of good systems analysis and design. The resulting specification consists of screen and report definitions, data structure definitions, and functional component descriptions.

The analysis toolkit has four basic components: structured diagramming tools, prototyping tools, a repository, and a specification checker. *Structured diagramming tools* are computerized tools for drawing, manipulating, and storing structured diagrams such as data-flow and entity-relationship diagrams, which are required documentation for various structured methodologies. Diagramming tools often reside on PCs or workstations that support graphics manipulation; at the minimum, they draw, update, and store data-flow and entity-relationship diagrams. To represent realtime system specifications, the basic diagram set must also include diagrams that show sequence and timing relationships between system processes and the effect of external events on the system.

Prototyping tools help determine system requirements and predict performance beforehand. Essential to prototyping are user-interface painters (screen painters, report painters, and menu builders) that prototype the user interface to give users an advance view of how the system will look and to identify and correct problem areas. Screen dialog and navigation with data entry and edits can be simulated with or without compiles; source code for record, file, screen, and report descriptions can be generated automatically.

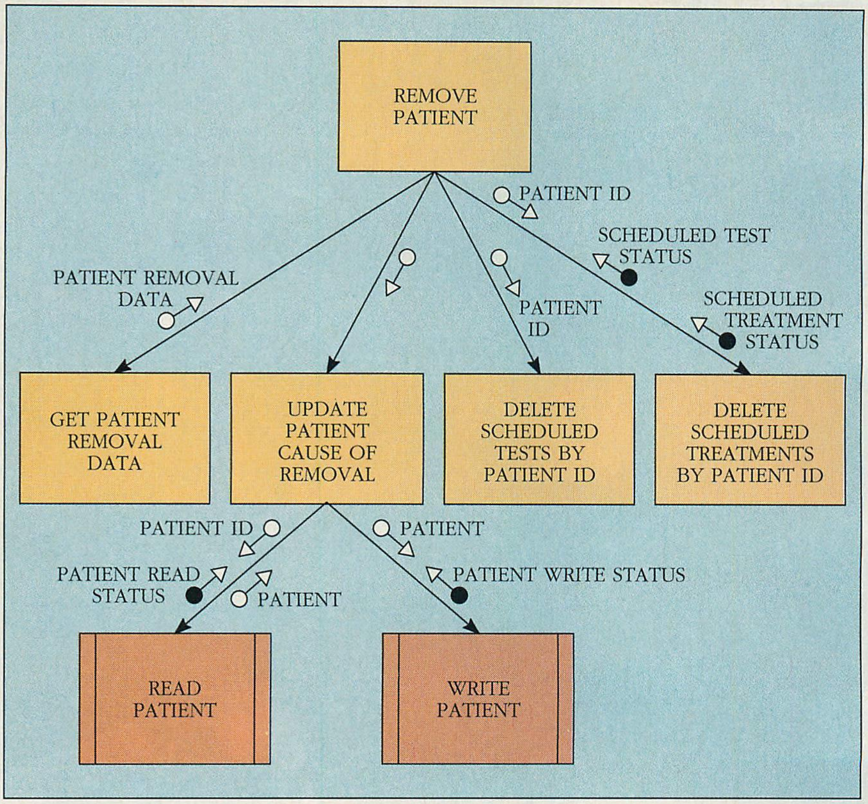
Also essential are executable specification languages. These are the most sophisticated prototyping tools, which involve specifying system requirements and executing specifications iteratively to refine, correct, and ensure completeness of the system to meet user requirements.

The CASE *repository* is a design dictionary for storing and organizing all software system data, diagrams, and documentation related to planning, analysis, design, implementation, and project management. Information entered once can be maintained and made available to whomever needs it.

The repository stores more types of system information, relationships among various information components, and rules for using or processing components than a standard data dictionary used in data management systems. The repository usually has many reporting capabilities that gauge the impact of proposed changes on the system, identify redundant or unneeded data elements, and resolve discrepancies. System diagrams and dictionary entities are linked within the dictionary, and some CASE tools provide automated means of verifying entities for completeness and correctness.

Automatic management of system information in an orderly, secure manner is a main benefit of the repository. It is impossible to keep the integrity of system information with only manual, informal management methods—especially in a team environment. The repository is often a relational database

FIGURE 5: ***Structure Chart***



A structure chart is a tree or hierarchical diagram that shows the overall design of the program, including program modules and their relationships. This particular structure chart was produced by the Analyst/Designer Toolkit from Yourdon Inc.

supported by a full database management system (such as IBM's DB2 and Ashton-Tate's dBASE III). This enables automatic population (filling) of the CASE repository from these outside dictionaries and databases.

A CASE repository should provide: security controls in the form of passwords to limit access to contents (or selected portions of contents); access privileges enabling the assignment to individual developers of read-only or full-update privileges; version controls to track the evolution of a system and allow multiple current versions, such as production, test, and individual developer working sets; multiuser access to allow multiple developers to concurrently access the same repository information, but not to concurrently attempt to update the same information; and change control to track changes and automatically incorporate them. To facilitate two-way information flow, CASE toolkits and workbenches must provide mechanisms for importing and exporting system information between the repository and outside sources.

A *specification checker* automatically checks the system specification as soon as the developer draws the first structured diagram or enters any information into the repository. The five basic types of error checking are: checking for syntax and type errors to enforce rules governing construction of diagrams; completeness and consistency checking to assure that a diagram is complete, contains all necessary information, and is consistent with all other system information and diagrams in the repository; functional decomposition checking for quality of tree-structured hierarchical diagrams; and requirements traceability to demonstrate that the work product created by the current development step can be traced to the work product of the previous step.

The first three checks, concerned with errors in one diagram, are the simplest types of error checking and the minimum expected from a CASE toolkit. However, specific procedures for these checks depend on each structured methodology the workbench supports. For example, DeMarco data-flow diagrams, Gane and Sarson data-flow diagrams, Martin dependency diagrams, and Ward-Mellor control-flow diagrams have different syntax rules, although they are all forms of the basic data-flow diagram.

Analysis toolkits can be extended to support the design phase. The analysis diagramming tool set is expanded to include diagramming and checking capabilities for hierarchical tree-structured diagrams (such as structure charts and decomposition diagrams) and procedural logic diagrams (such as action and Warnier-Orr diagrams).

Data design toolkits. These support the logical and physical design of databases and files: logical data modeling, automatic conversion of data models to third-normal form, automatic generation of database schemas for particular database management systems, and automatic generation of program-code-level file descriptions.

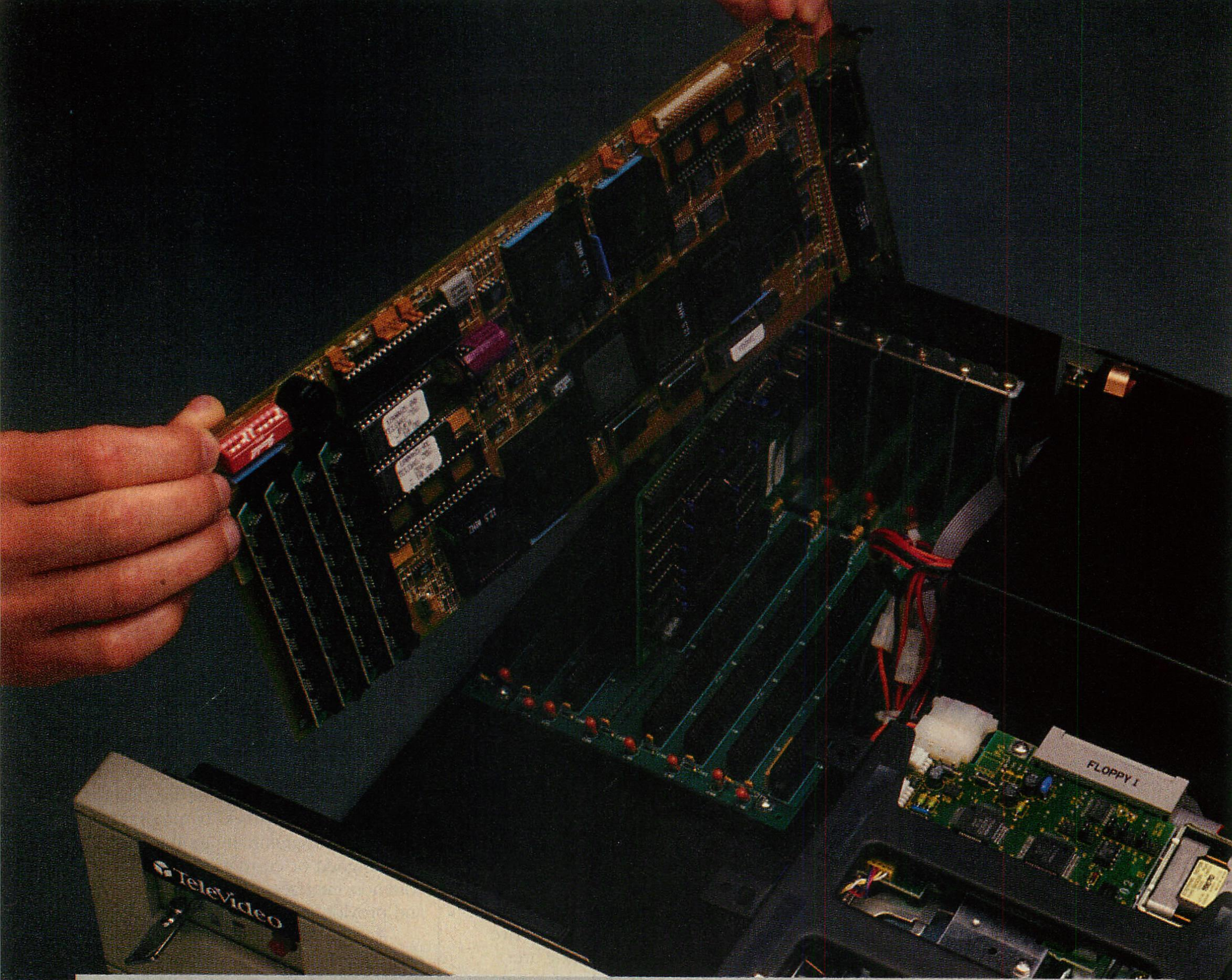
Programming toolkits. Supported tools include hierarchical tree-structured diagramming tools with a syntax and consistency checker; procedural logic diagrammer and on-line editor; CASE repository with information manager; code generator; code analyzer; file manipulator; test data generator; test coverage analyzer; file comparer; debugger; performance monitor; run environment generator and verifier; and target environment simulator.

Many of these tools are familiar to and already widely used by programmers. In a programming toolkit, they are designed or customized to share common interfaces and to call, use, and provide input to one another.

A code-generating tool is especially useful because it automatically produces code from a program design. CASE code generators can generate compiled, structured code in languages such as COBOL, PL/1, FORTRAN, C, or Ada; manage program specification and design information; increase productivity over manually writing program code; increase program reliability; generate documentation; support prototyping through screen and report painters; and reduce maintenance costs by maintaining code automatically.

To use a CASE code generator, the developer begins by creating the screens and/or reports required by the application. The developer stores information about the report format, individual data items, screen literals, and ordering of screens in the generator's dictionary or repository. It uses the information to generate source code and build prototypes. In lieu of a code generator, a PC-based analysis toolkit can produce this information and pass it into the generator's dictionary via a file.

The developer details the contents of each screen and report—for example, first by identifying each data ele-



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ment as input or output, and editing and validating each report data field, and specifying the internal data form of each data element. Additional program logic is specified; the program can be customized through use of subroutines, macros, or the generator's high-level procedural logic facilities. When the necessary program specification and design information is complete, the generator produces source code, database definitions, job-control language, and documentation.

Maintenance toolkits. Maintenance efforts and costs dominate the software life cycle of both information and real-time systems. In many management information systems (MIS) organizations (such as banks, factories, and distribution centers), more time is spent maintaining existing systems than developing new ones, and software maintenance is a major cause of software backlogs. CASE maintenance toolkits have desperately needed tools to analyze, document, reengineer, and convert existing systems.

The most useful tools include documentation analyzers (to read source code from existing systems and produce documentation), program analyzers (to evaluate execution paths and performance), reverse-engineering tools (to identify the model upon which a system is based), and restructures (to enforce structured programming and documentation standards. Automatic program restructuring tools, for example, not only can be substantially cheaper than manual rewrites, but also can reduce future program maintenance costs, facilitate program reengineering, and generate program documentation (including graphic views of the program data structures and procedural structure). They also can extend the program's useful life.

Project management toolkits. Automated project-management tools can help project managers better track, control, and report on software projects, thus improving software development and maintenance. To be most effective, these tools should be able to access the CASE repository in the toolkit or workbench. Besides storing technical system information, the repository should be the central location for current status, estimation, budget, and quality-assurance information.

A project management toolkit should include tools for word processing; interfacing to electronic mail; spreadsheets; project-management forms; configuration management for change, version, and access control; project plans; a calendar and task assignment system; estimation of time tables and scheduling; quality-control metrics; and a CASE repository with audit trail of all system information.

ENHANCING TOOL USE

A *framework* provides an infrastructure for fitting together, customizing, and managing individual software tools: CASE tools, traditional program implementation tools, and database management tools. It assembles old, new, and multivendor-supplied tools that otherwise would be incompatible with an integrated environment; and it enhances the portability of tools, allowing them to run across different hardware platforms. Tools in a framework present a common user interface, share common data interfaces, and run in the same hardware environment.

Organizations that benefit the most from CASE tools are those that already have in place a structured methodology for planning.

A *workbench* has integrated tools that automate the entire development and maintenance of software systems and software project management. The output of one life-cycle phase is directly and automatically passed on to the next life-cycle phase; the final product is an executable software system and its documentation.

A *methodology companion* provides computerized assistance for users on how to follow the steps and rules of a specific development methodology. To accompany either a toolkit or a workbench, information about the methodology is provided by help panels, menu choices, and *forcing functions*. Help screens and menus alert the developer to the next step and determine what input is required and what output will be produced. Forcing functions prohibit the developer from going to the next step in the methodology until the methodology companion judges that the current task is complete and certifies that its outputs are correct and comply with existing standards.

Embedding methodology information inside CASE tools makes it possible to have more extensive user help and system checking. It also minimizes the information that the developer must enter to perform tasks because information can be automatically transformed and passed onto subsequent tasks in the exact form that is required by the methodology.

CHOOSING THE RIGHT TOOLS

Prior to implementing a CASE product, developers should establish a structured methodology. Those with methodologies already in place can narrow the eligible products to those that support their techniques. In choosing CASE tools, it is important that you should consider whether the tools support existing hardware, how they integrate with other tools, which life-cycle phase they automate, whether they support enough methodologies to be useful within diverse divisions of an organization, and the sophistication of features (such as code generation, report generation, documentation, repository, design and analysis checking, and graphics support).

Organizations that benefit the most from CASE tools are those that already have in place a structured methodology for planning (or whose managers are willing to support the one chosen) and those that select well-integrated tools. Because a structured development methodology provides the overall frame for defining and linking software process steps, understanding structured methodologies is the key to making CASE work in an organization.

SUGGESTED READING

Bauer, F. L., *Software Engineering*, North Holland Publishing Co., 1972.

Brown, K., and Whinery, R., editors, *Data Structured Systems Development Methodology*, Ken Orr & Associates Inc., 1986.

DeMarco, T., *Structured Analysis and System Specification*, Yourdon Inc., 1978.

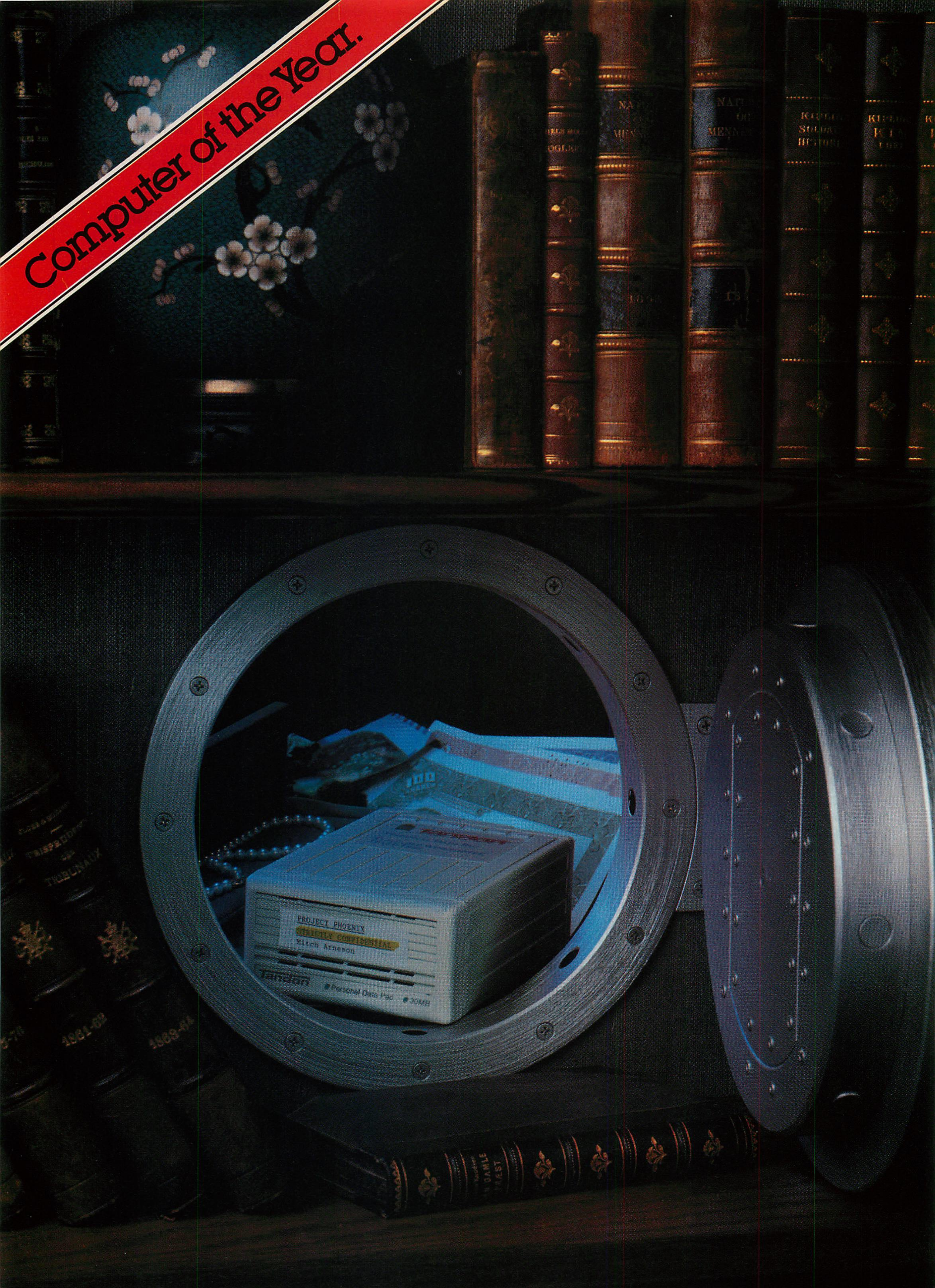
Higgins, D., *Program Design and Construction*, Prentice-Hall Inc., 1979.

Jackson, M., *Principles of Program Design*, Academic Press, 1975.

Martin, J. and C. McClure, *Structured Techniques: The Basis of CASE*, Prentice-Hall, 1988.

Page-Jones, M., *The Practical Guide to Structured Systems Design*, Yourdon Inc., 1980.

Carma McClure, Ph.D., is a consultant on CASE technology and vice president of Extended Intelligence Inc. in Chicago, Illinois. Her new book is CASE is Software Automation *(Prentice-Hall, 1988).*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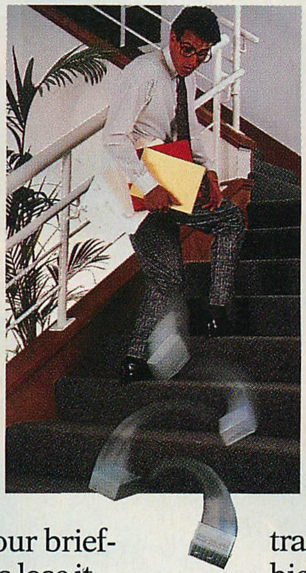

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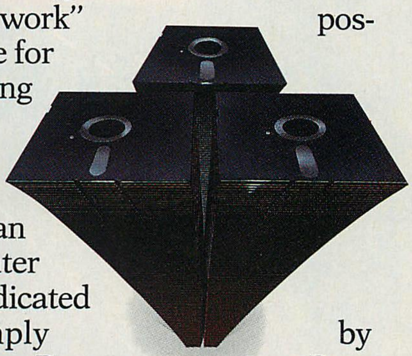

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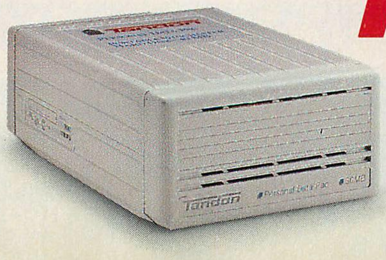

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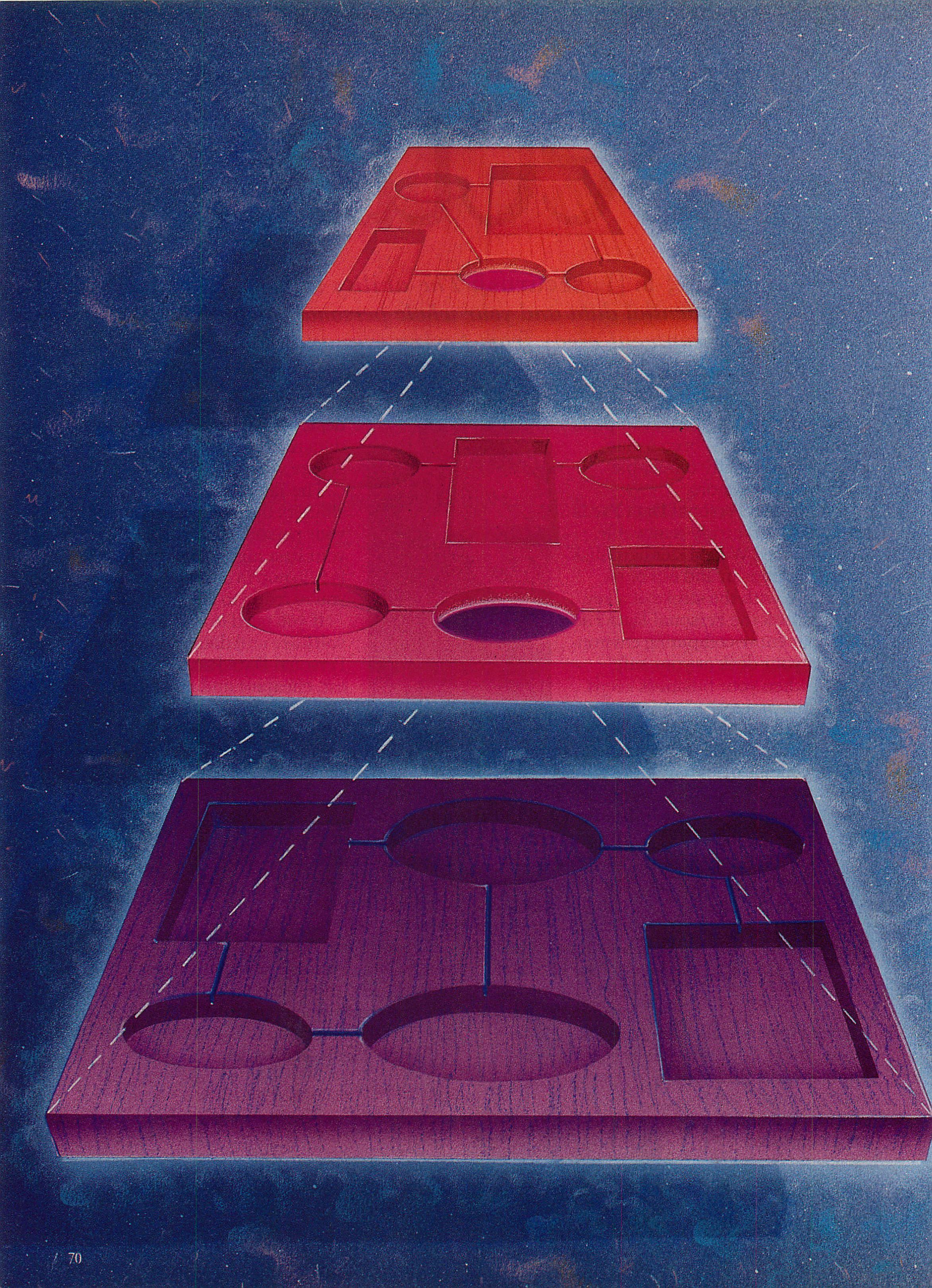


Excelling with CASE

As a veteran CASE tool for the PC, Excelerator shines. It delivers a broad spectrum of tools from which developers can customize their systems development efforts.

ANDREW TOPPER

Index Technology's computer-aided systems engineering (CASE) package is a leader among CASE tools for the PC. One of the first CASE products to debut on the PC, Excelerator began shipping in 1984 and has become the first CASE tool to sell 10,000 copies, according to Index Technology. A recent survey by CASE Research Corporation, an industry analysis firm in Bellevue, Washington, shows that Excelerator has the top market share of all commercial front-end analysis and design CASE tools.

More recently, Excelerator has led the pack by becoming the first CASE analysis and design tool to link to a third-party COBOL compiler for producing code on the PC. Although the current version produces only skeletal code, an improved linkage will allow systems analysis and design output to be used as input to automatically generate COBOL code on the PC and reduce the manual coding needed to implement a completed system.

A thorough analysis and design toolkit for developers of information systems, this $8,400 product uses a variety of software design methodologies in an integrated, data-dictionary-driven environment. Its extensive reporting capabilities and project-control functions support medium-to-large development efforts and make it easy to track development progress. A separate product, Excelerator/RTS, supports development of realtime systems (see the sidebar, "Excelerator For Realtime," p. 72, for details on this product).

When undertaking a development project, Excelerator's role begins after the developer and user have identified the purpose and scope of the system. The product's major contributions are to aid developers in analyzing and modeling data and processes that make up the system, generating documentation and diagrams to aid users in making early development decisions, using information generated during analysis to make design decisions (such as programming language restrictions, data access considerations, shared code, and data constraints), maintaining an up-to-date documentation trail, and generating pseudocode or diagrams for translating into executable code.

Other than linking to Micro Focus COBOL for the PC and several third-party code generators for mainframes, Excelerator does *not* provide specific tools for implementation and maintenance; developers must go to CASE tools specifically intended for implementing and maintaining systems.

Excelerator has the following seven major components:

- Graphics tools such as data-flow diagrams, entity-relationship diagrams, and structure charts and diagrams.
- The XLDictionary that provides a central repository for all Excelerator entities (objects), which include records, diagrams, charts, and reports.
- Documentation tools to chronicle all system components and relationships.
- Screen and report prototyping tools that give the end user a view of the system prior to code generation.
- Analysis reports that identify possible flaws or errors in system design.
- An import/export facility, accessed through the XLD Interface, to allow entities in the XLDictionary to be passed to and from projects within Excelerator.

ILLUSTRATION • GREG FITZHUGH

• Utilities for providing project security and control and maintaining the Excelerator environment.

A CASE product can be productive for an organization only if those using it are comfortable with the tools and planning methodology it supports. In this respect, Excelerator shines: it supports many diagramming tools and structured methodologies.

Excelerator automates the drawing of data-flow diagrams, entity-relationship diagrams, data-model diagrams, structure diagrams, and structure charts. The developer can specify use of either the Yourdon data-flow diagram or the Gane and Sarson technique, and either Chen or MERISE entity-relationship modeling (see "The CASE for Structured Development," Carma McClure, this issue, p. 50). The product's data-model diagrams support techniques described by developer C. W. Bachman, while structure charts are based on the Constantine methodology, and structure diagrams on the Jackson technique.

Excelerator's combined features—the diagramming techniques, data dictionary, analysis reports, and documentation preparation utilities—allow the developer to create a complete and thorough system that is highly efficient and easily maintained. The product's maximum parameters for developing complex systems and diagrams are shown in table 1.

Version 1.8 of Excelerator requires an IBM PC/XT, PC/AT, PS/2 Model 50 or 60, or 80386-based computer running DOS 3.1 or later; 640KB of RAM; a Microsoft or other compatible mouse; EGA graphics; and 4MB to 5MB of disk space with an empty dictionary. Index Technology also guarantees support for the AT&T 6300; Compaq Plus, Portable 286, and Portable III; and Hewlett-Packard Vectra. This version of Excelerator has been tested on IBM PC LAN Program 1.2 with the IBM PC Network Adapter (model 6450213), 3Com EtherSeries 2.4 with a 3Com EtherLink board, and Banyan Vines 2.0 with a 3Com EtherLink board. Index Technology plans to support the Novell network in a future release.

ACCESSING EXCELERATOR

The developer installs Excelerator by executing an Install utility and inserting 14 system diskettes as prompted—a simple process that takes about 20 minutes. If problems arise, the *Installation Guide* has a helpful troubleshooting section. Installation modifies the AUTOEXEC.BAT and CONFIG.SYS files to include setting environment variables and system minimums.

The developer uses the Pathmod utility, accessible from the Utilities diskette, to set up user access from within Excelerator to external word processing and project management software of the user's choice. System defaults for these external programs are Microsoft Word and Microsoft Project. Users can access the programs by selecting options from the Documentation menu. Excelerator also requires and provides a block security device for plugging into the parallel port; other devices requiring plug-in to the parallel port can connect through the block device.

To access Excelerator, the developer logs onto the system by entering user name and password; a pop-up menu then lists current projects from which the user can choose. The main menu (see photo 1), accessed by choosing a project or pressing Enter, makes available all tools (Graphics, Screens and Reports, Analysis, Housekeeping, XLDictionary, Documentation, XLD Interface). New projects are created by selecting Project Manager from the Housekeeping menu.

One drawback in the otherwise superb menu system is that the developer cannot view a data-flow diagram while also viewing contents of the XLDictionary or a data-structure diagram. This flexibility is sorely needed in all CASE products, and Index Technology intends to provide windowing support for this in a future version of Excelerator. Also confusing are an inconsistency in the location of the exit box on screens (from lower left to upper right) and the lack of a mechanism for specifying commands to allow direct access to the dictionary's Modify Record screen or Reporting facility.

The company has attempted to allow mouse or keyboard input from most every screen, but the capability so far is inconsistent. For example, the Esc key is used in most dictionary entry and update screens to exit or cancel the selected function, but it does not perform this function at the XLDictionary or Graphics menu screens. At these screens, clicking the mouse on the exit button brings up the previous screen. Index Technology easily could and should correct keyboard/mouse inconsistencies. Until it does, purchasers of Excelerator can avoid confusion by using the mouse for menu selection and the keyboard for data entry.

XLDICTIONARY AT THE HEART

The XLDictionary is the heart of Excelerator. It is a central repository that automatically stores and catalogs by

EXCELERATOR FOR REALTIME

Developers planning to develop realtime systems will find the same excellent features of Excelerator in Index Technology's Excelerator/RTS, a separate CASE toolkit that adds functions for analyzing and designing systems that support realtime events. Like Excelerator, the realtime product is priced at $8,400.

While most systems are transaction oriented, realtime systems are typically event- or activity-driven and are linked to computer-controlled machines or automated equipment. For example, a realtime system on the PC might be an automated manufacturing system linked to a data-collection computer or an automated conveyor system with bar-code readers connected to PCs or a LAN in a warehouse.

Excelerator/RTS supports the Ward-Mellor technique for realtime systems analysis and design, which uses the data and process modeling of basic Excelerator and adds control modeling (to address realtime events that control system operation). The three major diagramming tools of Excelerator/RTS are: the transformation graph, which is a data-flow diagram modified to include control constructs; the entity-relationship diagram used in traditional Excelerator; and the state-transition diagram showing the sequence of events that passes through an operating system.

An Events List identifies unique events that can occur, and design process specifications detail what actions will result from a specific event. The realtime product also supports block diagrams to identify electrical components and relationships and matrix graphs to represent machine logic. To verify design, the product reconciles different models in a system. For example, the entities in the data model are reconciled against corresponding components in the process model, which are compared against objects in the control model. This identifies discrepancies among different views of the system that can become problems during implementation.

— *Andrew Topper*

TABLE 1: *Excelerator 1.8 Specifications*

EXCELERATOR COMPONENT	MAXIMUM SIZE OR NUMBER
XLDictionary	Limited only by available disk space
Objects in a chart of diagram	75
Connections in a chart or diagram	150
Symbols in a chart or diagram	75
Levels of explosion	10
Ports on a chart or diagram object	24
Dictionary information for an object	5,120 bytes
Entities described in a chart or diagram file	100
Fields in a screen	40 to 50
Elements/records in a record	200
Codes in a table of codes	100

Excelerator specifies maximum sizes or numbers for objects, such as dictionary size and the number of symbols, levels of explosion, and fields on a screen.

project all information entered into Excelerator, including data-flow diagrams, structure charts and diagrams, processes, entities, relationships, and audit information. Each tool is linked to the dictionary so that the information entered into a project's diagram can be pulled into a structure chart, structure diagram, document, other diagram, or report.

All dictionary information is stored as sets of entities of the same type (for example, sets of data-flow diagrams). Each entity has attributes describing it, including name, definition, edit rules, and storage type; the user can access a screen to display these attributes (see photo 2). Excelerator's dictionary reports are numerous and complete, allowing the project-control staff to track progress and identify completed deliverables and remaining work.

DATA AND PROCESS MODELING

Excelerator integrates data analysis and design (data modeling) and process analysis and design (process modeling) to model all components of a software product or computer system. *Data modeling* shows the conceptual view of data in a system and identifies possible anomalies, while process modeling examines operations that transform data and their relationships.

Data modeling identifies information required to satisfy the system specification (a document defining the structure of a problem as the user views it and system requirements) and creates data structures and files to support programs acting on the data.

Data design typically involves normalizing records and elements (to eliminate redundancies and ensure access of each non-key element by a unique key), making physical design decisions regarding how data are stored and accessed, identifying different views of data, and creating physical records and relationships among records. The records often are combined into a schema or language-specific record description and used during programming.

Modeling data and relationships in Excelerator can produce either data-model diagrams, which pictorially represent one-to-one, one-to-many, and many-to-many relationships between two entities, and entity-relationship diagrams, which similarly depict relationships but clearly state the nature of relationships (see figure 1). Developers can use these diagrams to identify actions required to access data and data dependencies inherent in a system and, for complex applications, to communicate data design to programmers and team members.

Excelerator's data-model diagrams consist of ovals that represent entities and arrows connecting them to represent relationships. A single arrowhead on a connection identifies the *one* side of a relationship, while a double-headed arrow indicates the *many* side. Data-model diagrams can be manipulated (added, modified, or deleted) by selecting the data-model diagram option from the Graphics submenu.

Excelerator's entity-relationship diagrams support the Chen methodology, depicting entities as boxes, relationships between two entities as diamonds, and connections as lines. Relationships are labeled with numbers representing the type of relationship involved (for example, 1 to 1 or 1 to 5); an *M* can be used in place of numbers to indicate *many*.

The MERISE entity-relationship diagram, also supported by Excelerator, uses boxes with rounded corners to depict entities, circles to indicate relationships, and lines to connect entities and relationships. As with the Chen methodology, numbers are used to indicate relationship type. By adding another line with an arrow at one end, the MERISE methodology allows the developer to show movement of data from one entity to another, while the Chen methodology does not.

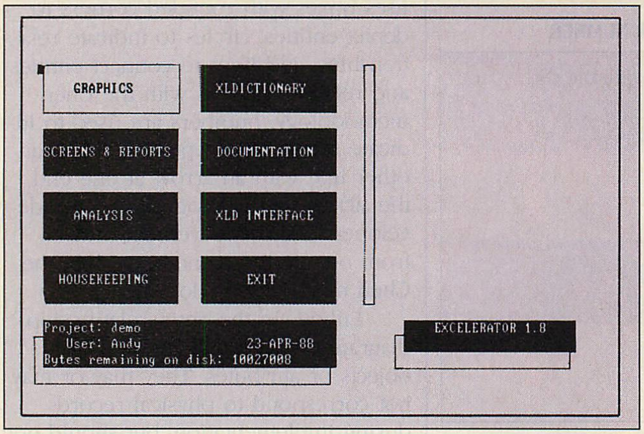
Entities in the entity-relationship diagram depict logical groupings of objects or attributes. They may or may not correspond to physical records during implementation, but should not be confused with them. Records are added via the XLDictionary option from the main menu and linked by name to entities in entity-relationship diagrams. The developer can select either the MERISE or Chen diagramming technique from the Project Manager option on the Housekeeping submenu. The developer then chooses the entity-relationship option on the Graphics submenu to manipulate the diagram.

Process modeling models each component of the system, specifies programs and subprograms to provide complete user functionality, and shows the flow of activities in the final system. A screen and report prototyping tool allows the developer to simulate how the system will look to the user. Prototypes that are created during analysis often are used along with the pseudocode to create final programs that make up the system.

Data-flow diagrams that show movement (transformation) of data among processes are the output of analysis and the basic tools for designing system processes (see figure 2). They allow the developer to identify and document at a broad level all system activities. A top-level data-flow diagram, called the context diagram, is separated (exploded) into levels, each one identifying an activity in a system and its inputs and outputs. In design, the diagrams are converted into structure diagrams, structure charts, and specifications for individual processes or pseudocode. The design phase also considers physical implementation restrictions on the system.

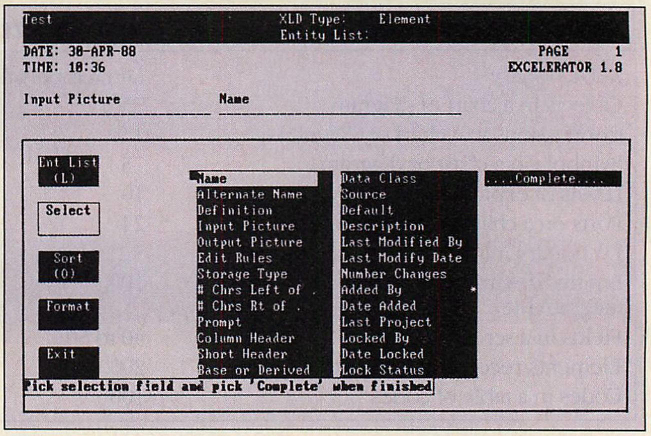
Excelerator's data-flow diagrams support the Yourdon technique. They depict processes (transforms) as circles (bubbles), data stores (repository) as parallel lines, and flows between data stores as connecting arrows. An external source component depicted as a

PHOTO 1: ***Excelerator Main Menu***



After logging on, the user is provided automatically with the main menu from which all features are available. Selections are made using either cursor keys or a mouse. Submenus often are printed to the right of the main menu.

PHOTO 2: ***XLDictionary Report Screen***



The dictionary maintains lists of all objects and their attributes (such as name, source, date added), which it uses to detect redundancies and omissions in projects. This allows extensive reporting during analysis and design.

rectangle shows relationships to entities outside the system. The Yourdon methodology is popular because it simply and completely represents entities making up a specific activity in a system.

The Gane and Sarson technique, also supported by Excelerator, allows developers to diagram a system's data flow and to identify repetitive activities in a system. Transforms are shown as squares with rounded corners, data stores as rectangles open on the right with two parallel lines on the left, external sources as three-dimensional squares, and data flows as arrows between entities.

Developers can select either the Yourdon or Gane and Sarson technique from the Project Manager option on the Housekeeping submenu. They then choose the data-flow diagram option on the Graphics submenu to manipulate the diagram.

In addition to being stored in the XLDictionary, data stores in a data-flow diagram can be related to an entity in a data-model diagram and in an entity-relationship diagram. External entities in the data-flow diagram are not related to any other object within the Excelerator system. Different design teams can use different data-flow and entity-relationship diagramming methodologies within a single copy of Excelerator. However, choosing a single methodology for all development efforts helps eliminate confusion among development teams and members.

STRETCHING ANALYSIS

New to version 1.8 of Excelerator is the Extended Analysis facility for appraising data structures and data usage before beginning design. It allows the developer to identify redundant elements, validate key elements, verify relationships, and ensure that records specified are normalized in third-normal form (with no repeating groups in the table or record and every non-key element functionally dependent only on a unique primary key). The facility generates six types of reports: record-content analysis, key-validation analysis, data-model-validation analysis, data-normalization analysis, screen/report data-usage analysis, and element-access and derivation analysis.

The *record-content analysis* examines records and elements within a project to identify redundant or incomplete information. Its reports identify empty and recursive records and those containing the same elements or many elements in other records. The *key-validation analysis* identifies missing or inconsistent keys for records in the XLDictionary. It reports records that have no keys or contradictory keys as well as differences between record keys and corresponding data-store index elements.

The *data-model-validation analysis* compares entities and relationships in the data-model diagram with underlying dictionary items. The *data-normalization analysis* consists of seven reports identifying possible normalization problems or inconsistencies. It also reports on records that contain no key elements or whose keys do not match descriptions in the corresponding data-model diagram.

The *screen/report data-usage analysis* allows the developer to evaluate relationships between screen and report designs and dictionary elements. It identifies all elements referenced in screen and report prototypes and any screens or reports duplicating some or all elements in other screens or reports. The *element-access and derivation analysis* compares elements in the XLDictionary with those depicted in data-flow diagrams and indicates potential contradictions. This analysis includes identifying unexploded data flows and all elements referenced in records, data flows, and processes.

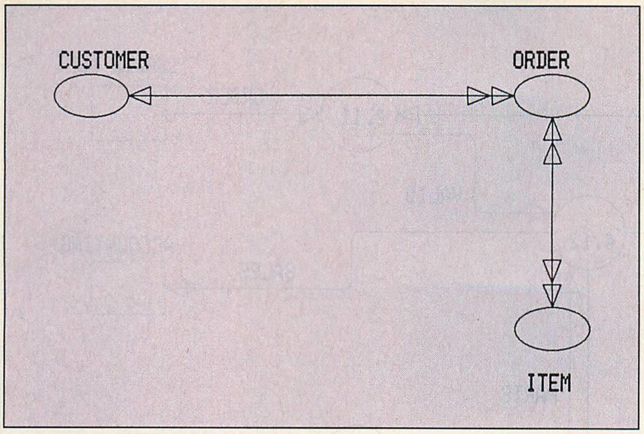
SLICK PRESENTATIONS

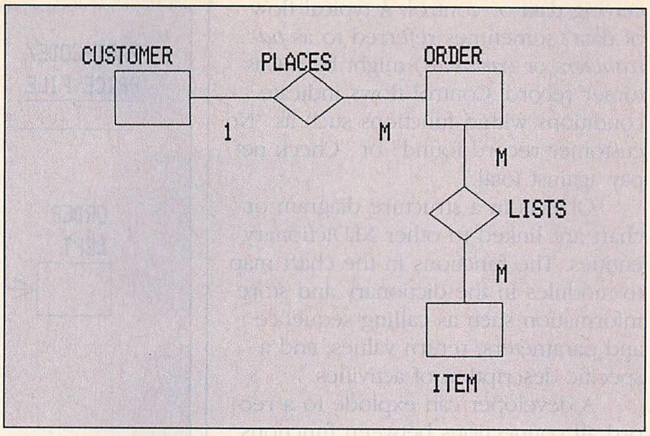
A slick, professional document is vital for presenting a system specification to users and management for approval before design begins. This specification represents the total system, including objectives and constraints; input, output, database, processing, and control requirements; dependencies among different aspects of design; and the way individual screens and reports appear to the user.

An effective Excelerator tool for showing the interaction of the system with external objects is the Presentation Graph (see figure 3). In addition, the Document Graph and Document Production facilities and Word Processing and Project Control options complete the package of tools a developer needs to create this document.

The Document Graph tool is a diagramming tool similar to data-flow and entity-relationship diagrams. It allows the developer to create a pictorial representation (tree structure) of chapters, diagrams, and reports making up the system specification document. A root object is added to the diagram to indi-

FIGURE 1: ***Data-Model and Entity-Relationship Diagrams***





In data-model diagrams, entities are shown as ovals, relationships as arrows. A double-sided, double-headed arrow shows the many-to-many relationship between order and item; double-sided arrows with one head on the customer side and a double head on the order side indicate one-to-many relationships. In entity-relationship diagrams, entities are shown as boxes, relationships as diamonds (labeled with the nature of the relationship); numbers or M (many) indicate the relationship type.

cate the top level of the document; each chapter is attached to it.

The completed representation showing how the system specification is put together can have as many as 100 items. *Document groups* include chapters and sections; they contain *document fragments* that represent diagrams, charts, reports, and text files. Document fragments can reference a diagram within Excelerator, a set of entities with the same type (such as all records or elements within the project specified), or a set of entities with the same type and prefix (such as all records that begin with Edit). All are identified by entity name and attributes. Fragments can represent the following information: XLDictionary entities, graph-analysis reports, external ASCII files, or other charts and diagrams.

The Document Production facility verifies contents, identifies errors, and prints the document. The document can be used as input to Xerox's Ventura Publisher for converting text and graphics to Ventura format and combining them with data from external sources to produce a publication-quality document. Ventura is the only desktop publishing software supported by Excelerator to date.

The Word Processing and Project Control options allow the developer to execute external software from within Excelerator, assuming enough memory is available. The Word Processing option was used successfully in this review to execute WordPerfect from within Excelerator. Because Excelerator works only in monochrome, such external packages will appear monochrome, even on color monitors.

PUTTING THE PIECES TOGETHER

Once the system specification meets user needs, system design can begin. Excelerator's design tools do not directly address the first step in design—database design—but the Extended Analysis facility helps developers determine physical limitations and suitable work-arounds. For example, it can identify the need for splitting files between two physical disks.

The product directly addresses the second design phase, which is application design. Basic application design identifies general or global constraints on the system as well as possible program menu structures, function key assignments, and other such activities. More detailed application design translates data-flow diagrams at the lowest level into descriptions that a program can use to begin coding.

Processes identified in analysis are exploded to functions in a structure diagram and structure chart during the design phase. A structure diagram is a hierarchical representation that shows movement and transformation of data within a process in a data-flow diagram; the structure diagram also shows the detailed conditional logic within a particular process or procedure.

Excelerator supports the shapes and symbols of the Jackson methodology, in which a rectangle depicts a function and lines connect a function to its components. The top-level function represents the program, with each lower-level function designated as subroutines or subprograms. A single program can be broken down until individual routines show low-level activities such as read master file, print paycheck, or delete transaction record. Notations attached to individual functions show conditions, iterations, and parallel processing.

Functions drawn in a structure diagram can be parents to other diagrams; the entire system design can be broken down into more and more detail until program-level functions are created. Subfunctions identified in the higher-level diagram become the root function for dependent lower-level diagrams. When a function can no longer be broken down, the root function maps to a program and the lowest-level functions in the diagram map to modules that contain detailed logic.

The structure chart for system design focuses on how a single process is implemented within a system but differs from structure diagrams by supporting the flow of data among functions. Excelerator supports the Constantine technique for structure charts (see figure 4). The components of this diagramming tool include new modules or functions drawn as rectangles, functions already defined as rectangles with parallel lines on both ends, global data stores as hexagons, system devices (such as tape drives and printers) as slanted rectangles, and system environments (for example, operating systems) as a circle opened on its upper left periphery. Connecting lines with labels between parent and child functions identify the subfunction's characteristics or conditions.

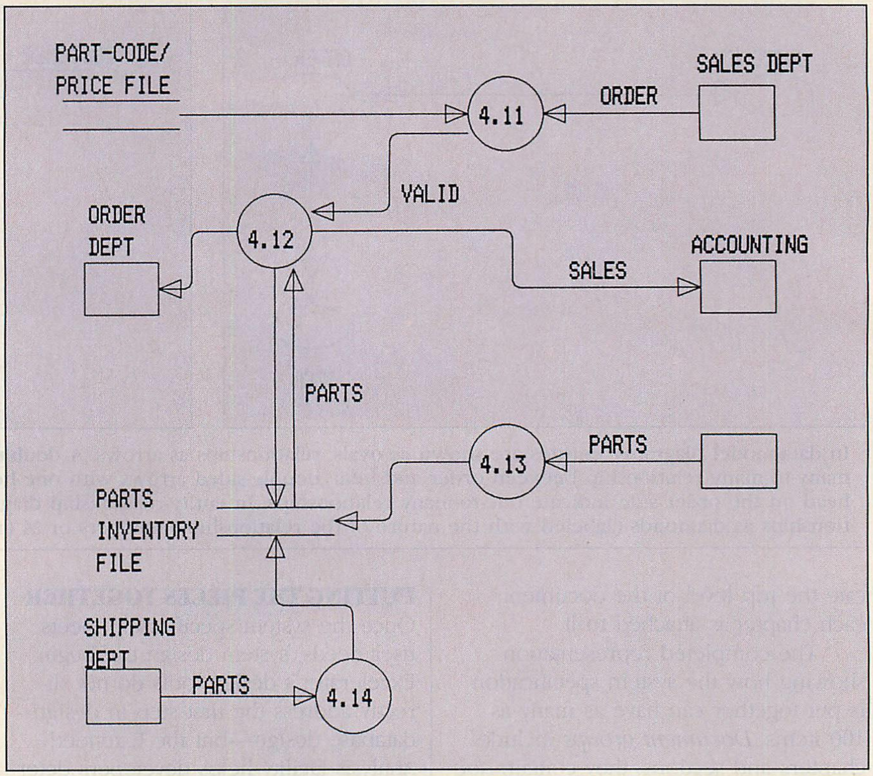
The most significant attributes of the relationship between the higher- and lower-level functions drawn in the structure chart are control and data flows. Flows are drawn as arrows next

to lines connecting the functions; the arrow points toward the function receiving data or control. A typical flow of data (sometimes referred to as *parameters* or *variables*) might be a Customer record. Control flows indicate conditions within functions such as "No customer record found" or "Check net pay against total."

Objects in a structure diagram or chart are linked to other XLDictionary entities. The functions in the chart map to modules in the dictionary and store information such as calling sequence and parameters, return values, and a specific description of activities.

A developer can explode to a record all connections between functions mapped to corresponding entities in the dictionary and can list parent and child connections as well as records and control data structures passed. System devices in the diagram or chart refer to physical I/O devices, files, or an external operating system; they can be further defined in the dictionary to include information on make, model, serial number, vendor, power requirements, operating system, and protocol.

FIGURE 2: ***Data-Flow Diagram***



Data flowing through an inventory system can be shown by a data-flow diagram. The shipping department (external to the system) sends parts information to process 4.14, which places it into the inventory file. Process 4.12 receives valid order information and sends sales information to the accounting department.

VALUABLE PROTOTYPING

A valuable tool in the design of any software product or system is the screen and report prototype. This facility allows the developer to simulate for the user what the final product will look like and, at some level, how it will function. Prototyping tools have been available for most mainframe application development packages for many years.

Excelerator provides several useful tools that together allow the developer not only to create sample screens and reports, but also to have the user enter data into specified files and run actual reports against that data without having to write code. Screen and report prototypes in Excelerator use the elements in the XLDictionary and can reference tables of acceptable values set up by the developer.

To create a prototype screen, the developer specifies a unique name for the screen and describes its function, then indicates the next screen. A Screen Painting facility allows the developer easily to add screen headings, field labels, and locations on the screen where specific elements will be entered. Elements can be set up with attributes such as reverse video, blinking, or skip, and they can use edit tables stored in the dictionary. The Screen Painting facility also has options for cutting, pasting, deleting, blocking, and repeating screen elements.

Once the screen is completed, the developer can generate a data map for COBOL, C, BASIC, or PL/1. Excelerator generates a file or prints out the structure for the elements defined on the screen in the format for the language specified. Screens are associated with files; the developer can designate record and key lengths for screen data entry. The system presents a menu allowing the user to add, modify, and delete records in the file. Once these records are added to the file, they can be reported on to allow users to use screens prior to approving final design.

Creating report prototypes in Excelerator is similar to creating screens, except the extensive Screen Data Reporting option gives the developer space for 132 characters across instead of 80. The report can contain labels and elements that exist in the dictionary, has options for repeating elements, and can be printed as output to a file or the screen. One missing feature is the ability to group elements at the report header and footer level, such as combining individual month, day, and year elements into a date.

Excelerator, however, does give the developer total control over format, selection criteria, and sort order for reports generated. The reporting capability is excellent, offering the versatility to create almost any report. The selection criteria allow selection of a single element or groups of elements. Common selection conditions such as >, <, and = are supported via selection rules. The output sequence for the report can be on a single sort element or on a combination of elements with a primary sequence, a secondary sequence, and so on.

The Format option allows the developer to use a predefined output format, which simply prints the contents of the record, or a user-defined format, with which the developer can select the elements to be printed and the order of printing. Elements can be positioned on the report, and report width can be expanded. Additional report attributes that can be customized are title, headers, counts on nonblank entries, and totals for numeric values. All Excelerator reports can be saved and later run by name with the output directed to either the screen, a file, or the printer.

ONE SMALL STEP

Excelerator is making headlines because it recently became the first analysis and design CASE tool that provides a linkage to a PC code compiler—Micro Focus's Excelerator Interface (an option to add to the COBOL/2 Workbench). The linkage consists of two products: the Micro Focus interface for $500 and Index Technology's XL/Interface for Micro Focus VS COBOL for $650. It also requires version 1.8 of Excelerator and version 2.02 or later of the Micro Focus COBOL/2 Workbench.

The interface can turn structure charts, screen and report definitions, and dictionary entities defined in Excelerator into skeletal COBOL programs that contain data structures for screens and reports (01-level definitions), record and element definitions, and COBOL Procedure Division sections that map to lower-level functions. Program documentation, pseudocode, and COBOL source code stored in the XLDictionary are placed in the COBOL programs but are designated as comments. The primitive skeletal code produced on the PC can be made executable using the COBOL/2 Workbench.

While this interface does not come close to generating all or most of the COBOL code required for even a simple screen-entry program, its importance is that it represents a major step in completely automating software development on the PC. An improved product that generates executable code is on the horizon, according to Index Technology.

Developers of COBOL applications in large management information system (MIS) shops may find this linkage useful for doing mainframe development on the PC—skeletal coding can be done on the PC, reducing the amount of mainframe time required, and the application uploaded to the mainframe. Developers can also develop and run on the PC, or develop on the PC for customers to run on their mainframes.

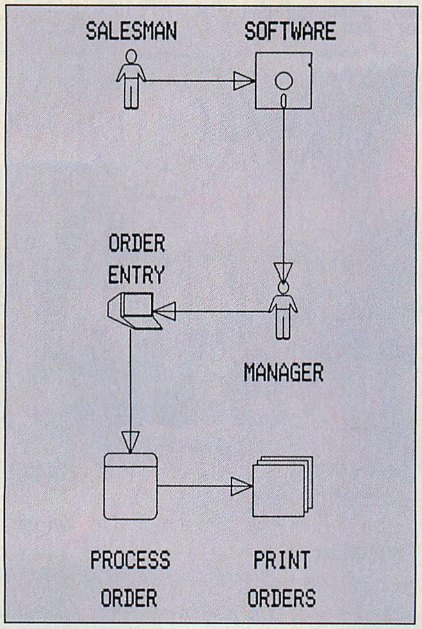
COMPLETING THE TOOLKIT

Where Extended Analysis identifies inconsistencies, redundancies, and omissions that can rear their ugly heads during data modeling only, the Graph Analysis, Entity List, and Report Writer identify them throughout the development project. *Graph Analysis* identifies inconsistencies, redundancies, and omissions in a design. It provides verification, analysis, and level-balancing reports for examining and evaluating data-flow diagrams and graph-explosion reports for examining explosion paths associated with diagrams and charts. Each report can be extremely helpful in determining if a proposed system design is consistent and can be mapped into a complete, integrated application.

The verification report identifies illegal connections and unconnected (free-standing) objects, while the analysis report examines inputs and outputs for each process to identify problems such as a process that shows data flowing out with no input or one in which output cannot be derived from input. The level-balancing report identifies inconsistencies between different explosion levels, such as input and output data flows on a high-level diagram that do not match those on the next level. The graph-explosion report details as many as nine explosion levels; it looks for redundancy and missing levels.

The *Entity List* extracts a subset of entities from the XLDictionary, such as all processes defined by a single analyst on a development team. The developer uses these lists for transferring or protecting data using the XLD Interface, or analyzing data or generating reports using the Report Writer. Entity lists can be saved and reused and can also be chained to create lists of unlimited size. Valid operations on entity lists (including union, intersection, difference, and subtraction) allow extraction of subsets of entities from one or more lists.

FIGURE 3: ***Presentation***



The Presentation Graph presents sophisticated specification documents to managers and users for approval.

With the *Report Writer*, the developer creates reports to analyze subsets of dictionary data. A report might document what is complete and incomplete on a project, what inconsistencies were found, and which were corrected. Once designed, reports can be reused or modified. These reports may include many entities and can use five preset formats: audit (to list control information such as who created and changed an entity and when), list (to display on the screen the name of all items in an XLDictionary entity), missing entities (to list entities referenced in a report but not defined in the XLDictionary), output (to print screen descriptions), and user-defined (to allow the user to select entities or attributes and position them on the page).

The XLD Interface menu provides options for controlling data sharing in a multiuser environment so that data can be transferred between projects and protected from unauthorized users. It allows import and export from other Excelerator projects. Entities can be locked to prevent modification anytime, including during export.

Excelerator provides excellent project-control and security capabilities by allowing the developer to add and maintain users with differing access restrictions. The developer can define three types of users: system managers who maintain the Excelerator system including user IDs and passwords; project managers who assign users to projects; and users who are able to access specific entities.

Users are stored in the XLDictionary and are considered entities just like elements, records, or functions. The user entity in the dictionary contains information such as an alternate name, definition, location, and responsibilities for other dictionary entities.

Once users are added to the XLDictionary, they must also be given a password and access privileges from the System Management facility accessed via the Housekeeping option from the main menu. The project manager can grant them read, limited, or master access to specific projects. Read access prohibits the user from adding, modifying, or deleting project entities; limited access prohibits the user from modifying objects locked by another user; and master access allows the user to modify all entities, even those locked by other users.

The level of user access combined with entity locking allows developers to exercise considerable control over projects in Excelerator and minimize

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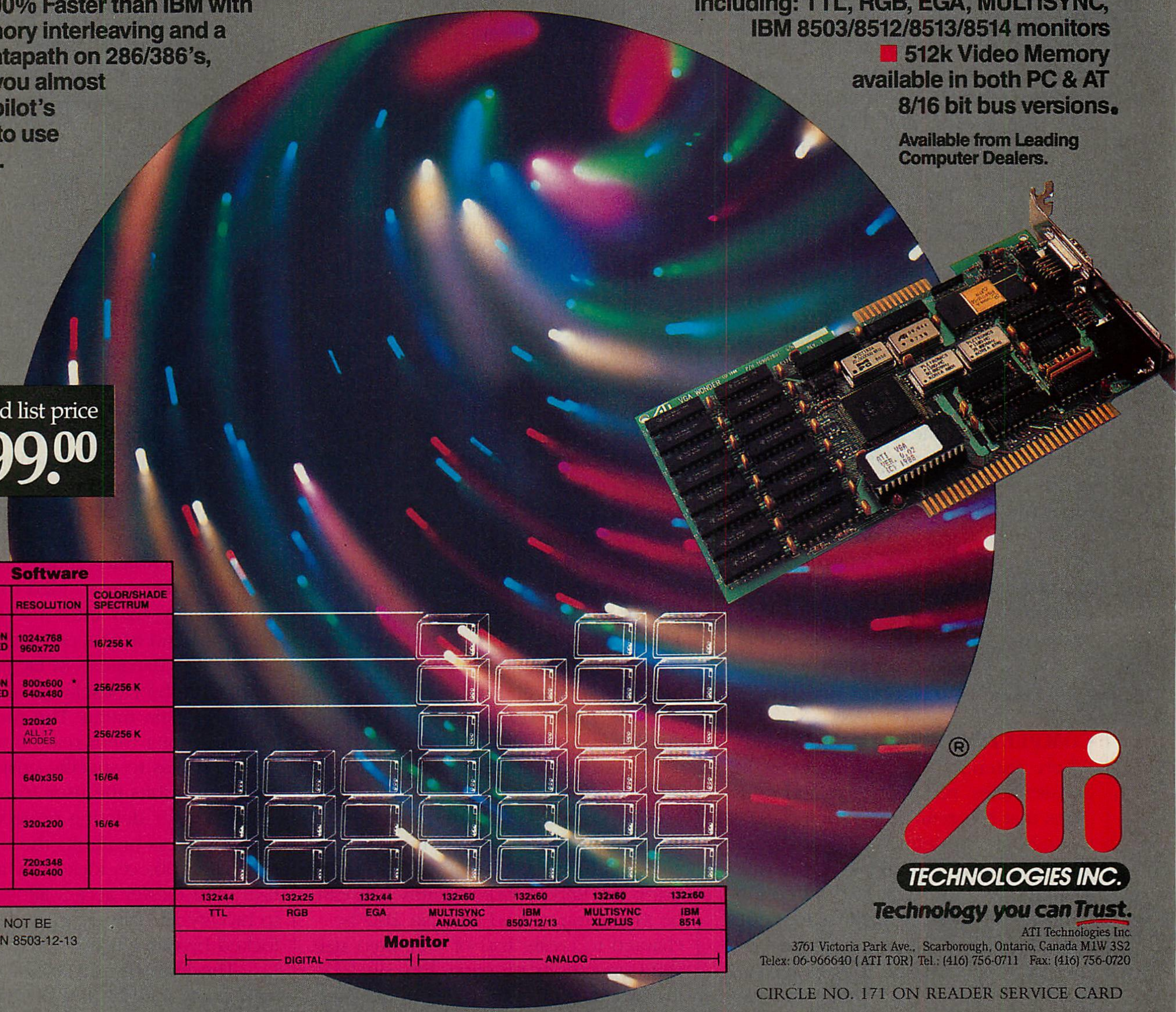

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EGA	640x350	16/64
CGA	320x200	16/64
MDA	720x348 640x400	

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	DIGITAL			ANALOG			
	TTL	RGB	EGA	MULTISYNC ANALOG	IBM 8503/12/13	MULTISYNC XL/PLUS	IBM 8514
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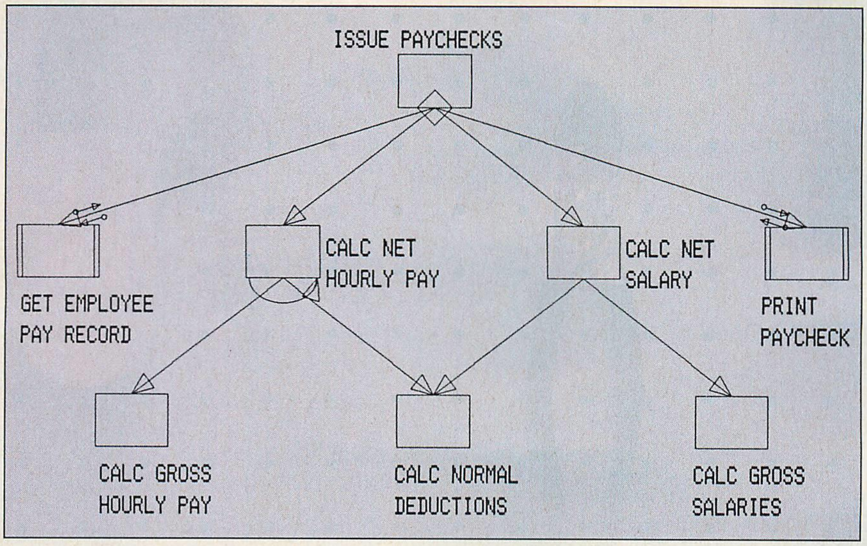
FIGURE 4: *Structure Chart*



A structure chart shows the bottom-up transformation of pay data from the calculation of gross pay and deductions to the calculation of net pay, the modification of the pay record, and the printing and issuing of the paycheck.

TABLE 2: *Summary of Excelerator Features*

CASE COMPONENT	EXCELERATOR
Structured diagramming tools	Data-flow diagrams, entity-relationship diagrams, data-model diagrams, structure charts and diagrams
Prototyping tools	Screen and report painters, screen data entry and reporting
Repository	XLDictionary
Security controls	User IDs and passwords
Access privileges	Master, limited, and read-only
Version control	Entity locking
Multiuser access	Local area network
Change control	Entity locking
Specification checker	Analysis reports
Syntax checking	Verification reporting
Completeness checking	Verification reporting
Functional decomposition checking	None
Cross-diagram checking	Explosion reporting
Requirements traceability	Level balancing reporting
Links to code generators	For the PC: Micro Focus COBOL; for the mainframe: Pansophic's TELON, Sage's APS Development Center, Cognos' Powerhouse, A1 Lee and Associates' Magec.

Common components of CASE tools are listed in the left column and corresponding Excelerator features in the right column. Excelerator is impressive in that it provides support for almost all CASE features, and links to code generators.

problems from system changes. With forced log-in and password protection, Excelerator controls system-level access to the CASE software. Furthermore, by assigning users different access restrictions and diagramming methodologies, Excelerator controls access to projects—a facility that is unavailable in many CASE products.

Entity locks and descriptions of responsibilities give Excelerator the ability to control access to individual sections and activities of projects. Entity access is especially useful for projects involving different divisions of a single company as well as those in which several companies are working jointly on a project.

Documentation accompanying Excelerator is well written and complete and gives clear, concise, relevant examples and descriptions. It includes a *Reference Guide*, a *User Guide*, *Release Notes*, an *Installation Guide*, an *Extended Analysis* guide describing data modeling, and a *1.8 Output Enhancements* guide for use with Ventura Publisher. A quick-reference card and keyboard template are also valuable. Only the *Tutorial* falls short; it teaches the novice how to use the tools but lacks prepared samples with which the developer can experiment.

Customer support includes a hotline number, a 90-day diskette warranty, and service plan. Extended service, training, field support, a newsletter, user group membership, and a consultant-referral program are optional.

FULFILLING THE CASE PROMISE

Excelerator on the PC is efficient and easy to use. It delivers a broad spectrum of tools addressing most, but not all, systems development stages and providing a complete systems analysis and design toolkit for PC developers. Its most unprecedented accomplishment to date is its ability to link with Micro Focus COBOL to produce skeletal code on the PC.

With the exception of mouse and keyboard inconsistencies, Excelerator delivers an excellent user interface and comprehensive features (see table 2) and fulfills the promise of CASE and structured methodologies for the PC developer. When it is migrated to a windowing environment to provide a means of accessing more than one facility at a time, this product will serve as a model for other CASE tools.

Excelerator's LAN support and project-control features make it especially beneficial to medium and large development efforts (consisting of 3 to 15 people), while its $8,400 price makes it an unlikely candidate for smaller projects. PC developers who can afford the price would do well to acquire Excelerator. Those ultimately benefiting will be the end users of software developed using this tool.

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617/494-8200
Excelerator 1.8: $8,400
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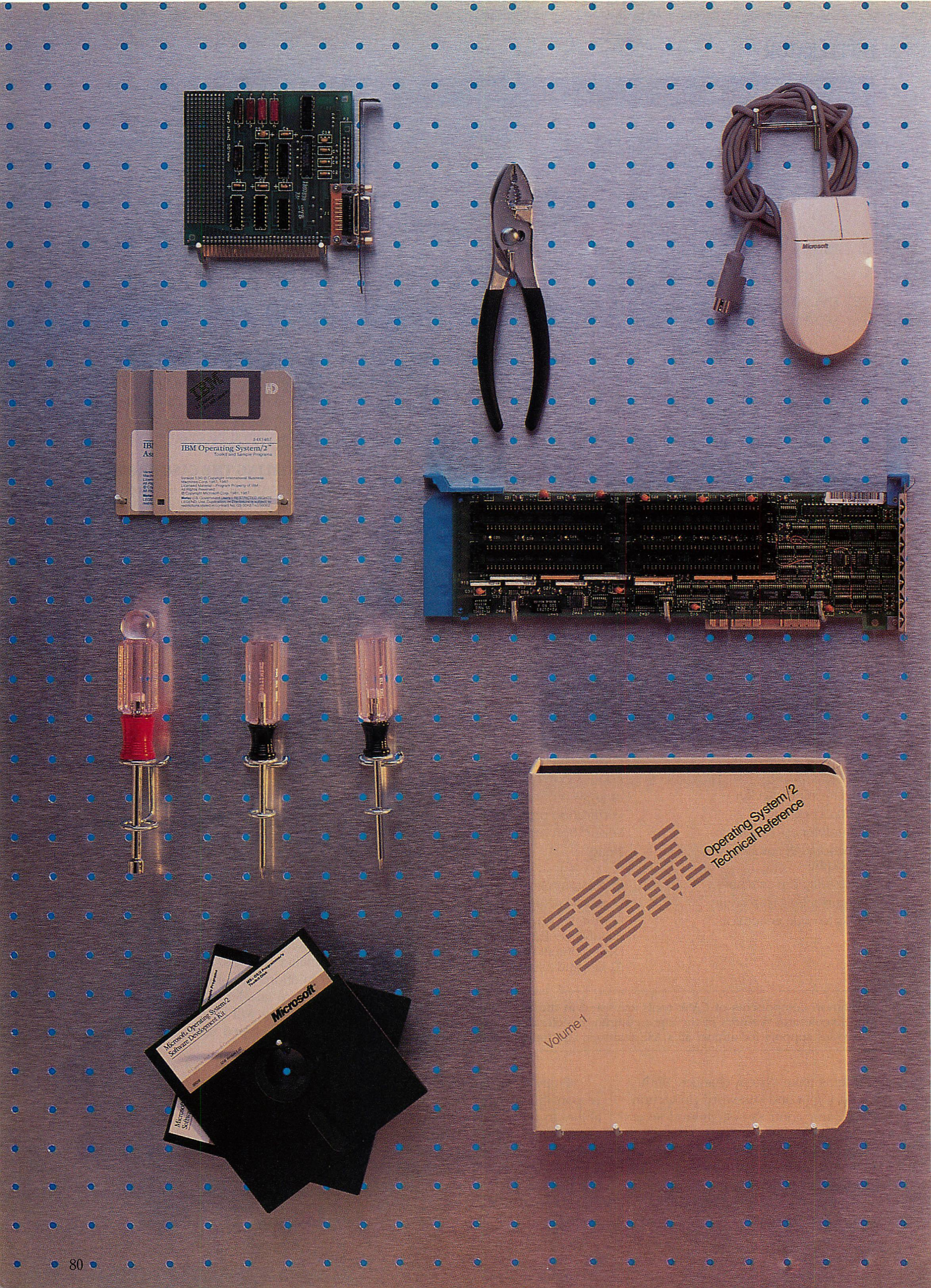
IBM Operating System/2
Toolkit and Sample Programs
Microsoft
Microsoft Operating System/2
Software Development Kit
IBM
Operating System/2
Technical Reference
Volume 1

OS/2 Workshop

Many quality application development tools await those who venture into the OS/2 environment. What's more, these tools can produce applications not only for OS/2, but also for DOS.

TED MIRECKI

Migration to new computer systems, whether hardware or software, usually requires a driving force. The initial timid attempts at desktop computing were driven mainly by the use of VisiCalc on the Apple II. Later, the torrent of DOS systems was set in motion by the widespread acceptance of Lotus 1-2-3. The next generation in the evolution of the desktop system—OS/2—has been waiting for its own driving force, which now could well be here.

The compelling reason to move to OS/2 need not be a dazzling new end-user application but rather that it is an excellent platform on which to develop such a program. Moreover, developing under OS/2 does not require betting the business that OS/2 will be widely accepted by end users—the fruits of development can be DOS applications as well. With the limitations of DOS, cross-developing under more capable systems is an established practice, and the new operating system simply is a very attractive alternative.

OS/2 offers many important advantages for software development: multitasking, memory protection, and vast memory spaces (at least for the moment—remember how quickly the PC's seemingly inexhaustible 640KB became a straitjacket). In short, OS/2 provides most of the facilities of a *real* operating system, the kind that is familiar to most professionals who develop on large systems.

In addition to OS/2's capabilities, an ingredient important to its ultimate acceptance among developers is the availability of development tools. The outlook here is positive as well. Such tools are now offered by a variety of sources, and they are no longer bundled into large expensive packages.

The tools needed for OS/2 development are:

- The operating system itself
- A compiler with an OS/2 library
- An assembler
- An editor
- A debugger
- Header files defining system functions
- Technical documentation of the system calls
- A linker capable of building protected-mode executables
- The Bind utility and API.LIB (for building family-mode applications)

THE TOOLS FOR THE JOB

At present, only one source provides all of these items in one package—the Microsoft Software Development Kit (SDK)—which sells for $3,000. Expensive, yes, but SDK delivered the earliest access to the operating system and the other development tools. Purchasers of the original SDK release received OS/2 six months before its official release; the current release, sent to original purchasers at no additional cost, contains the only currently available version of the Presentation Manager. Developers who need an early start on building Presentation Manager applications have no alternative.

Except for the Presentation Manager, the other tools for OS/2 development have been unbundled and can be

PHOTOGRAPHY • BRUCE WELLER

TABLE 1: *Features of OS/2 Programmer's Toolkits*

	IBM	MICROSOFT
PRICE:		
Base Programmer's Toolkit	$750	$350
API Reference	200[a]	included
Total	$950	$350
Version 1.1 update	free	not known
DEVELOPMENT TOOLS:		
Link tools[b]	○	●
IMPLIB	●	●
Family-mode utilities[c]	●	●
Message-binding utilities[d]	●	●
C header files	●	●
MASM include files	●	○
Utility programs	○	●
Sample programs with source code	●	●
DOCUMENTATION:		
Function reference	●[a]	●
IOCTL reference	●[a]	●
Device driver reference	●[a]	○
Instructions for tools	●	●
Learning guide	●	●

● = *Yes* ○ = *No*

[a] *IBM OS/2 Technical Reference.* [b] *LINK, LIB.* [c] *BIND, API.LIB.* [d] *MKMSGF, MSGBIND.*

Both toolkits contain similar development tools but different documentation. The IBM reference includes more in-depth discussions on systems-level programming (device drivers, exit lists), but the API documentation is an extra-cost option.

purchased from several vendors. Two products provide sets of tools specific to the new environment—the OS/2 Programmer's Toolkits, one each from IBM and Microsoft. Both contain many of the necessary components in one package (see table 1). Even at list price, the total cost of individual tools is significantly less than the cost of the SDK (see table 2), and many of the items are available at discount prices.

The operating system. As with DOS, OS/2 is supplied at retail level, not by Microsoft but by the manufacturers of hardware, with the operating system tailored to the specific requirements of each machine. (In a break with this tradition, Microsoft itself sells the SDK, in order to give developers a head start before its commercial release.)

The major manufacturers of IBM compatibles have already announced their versions of OS/2 or are planning to do so soon. Because OS/2 interacts much more closely than DOS with the underlying hardware, the differences between these versions are much greater than differences between versions of DOS for various machines. Although practically all versions of DOS run on most PC and PC/AT compatibles, OS/2 is far more selective. The safest approach is to purchase OS/2 from the hardware manufacturer, if available.

To demonstrate the problem, *PC Tech Journal* staff members tried booting OS/2 versions from five manufacturers on a variety of hardware (table 3 shows the results). This was not an exhaustive test of compatibility but indicates which versions booted on the systems at hand.

This compatibility situation is dynamic—a machine's behavior with the current version of another manufacturer's OS/2 does not imply the same behavior with future versions. For example, the initial release of Dell's OS/2 did not run on Dell's own System 220 or on the Everex machine; however, the current version, release 1.01, does. Microsoft's version 1.1 boots on all IBM PS/2 Models 50, 60, and 80, but it does not support a mouse connected to the system board mouse port. Also, on some PS/2 systems with ESDI controllers, the Microsoft version cannot write to the hard disk. New device drivers for the PS/2 mouse and ESDI disks should be available from Microsoft by the time this reaches print.

Although a developer must choose a version of OS/2 to develop *under,* fortunately he need not choose a version to develop *for*—at the API level, the versions from all manufacturers are equivalent. Therefore, a program developed under, say, IBM's Standard Edition version 1.0 will run under all manufacturers' implementations of that version and later ones. The compatibility problems lie only in matching OS/2 to various hardware, not in matching applications to various versions of OS/2.

Instead of choosing an OS/2 for an existing machine, a developer may want to choose a machine compatible with a particular version of OS/2. Currently, developing Presentation Manager applications requires a machine that can run the OS/2 from Microsoft's SDK. The Presentation Manager will be available in other versions, but some enhancements, such as IBM's Extended Edition, will be offered only by specific vendors. Developers must consider whether a particular vendor will provide timely OS/2 updates, if at all.

Compilers. One of the attractions of OS/2 is the promise of productivity gains through multitasking. For developers, this means the ability to relegate lengthy compilations to a background task, while performing other activities in the foreground. However, an OS/2 compiler needs more than the ability to execute in protected mode; it also must generate code suitable to the target operating system.

Program entry code must be totally different, and system-level services must conform to the correct application program interface (API). For example, in a DOS library the C **open** function executes INT 21H, function 3DH, while in an OS/2 library it calls DosOpen. For this reason, converting a compiler is more difficult than porting an application; it typically requires extensive rewriting of the runtime library.

OS/2 compilers are available or have been announced for the following languages: BASIC by Basis, IBM, and Microsoft; C by IBM, Lattice, and Microsoft; COBOL by Austec (formerly Ryan-McFarland), IBM, Micro Focus, Microsoft, and Realia; FORTRAN by Austec, IBM, and Microsoft; Modula-2 by Greiner and Logitech; Pascal by IBM and Microsoft; and Prolog by Arity.

Any of these compilers is acceptable for developing high-level applications that use built-in features to perform system-level operations (for example, the WRITE key word in FORTRAN instead of a call to DosWrite). For calling the system directly, C is the most convenient because the system API is patterned after the C programming model.

TABLE 2: *Cost of OS/2 Development Tools*

	IBM	OTHER	
Operating system	$325	$325	(AST, Compaq, or Dell Computer)
Programmer's Toolkit	750	350	(Microsoft)
API Reference	200	—	(Included in Programmer's Toolkit)
C Compiler	525	450	(Lattice or Microsoft)
Macro Assembler	225	150	(Microsoft)
Total price	$2,025	$1,275	

A complete set of tools purchased individually costs significantly less than the $3,000 Microsoft Software Development Kit. However, the SDK provides one component not available elsewhere—a beta version of the Presentation Manager.

TABLE 3: *OS/2 Compatibility across Hardware Systems*

	AST OS/2 1.0	COMPAQ OS/2 1.0	DELL OS/2 1.01	IBM OS/2 1.0	MICROSOFT OS/2 1.1[a]
AST Premium/286	●	●	●	●	●
AST Premium/386	●	○	○	○	○
Compaq Deskpro 386[b]	○	●	●	●	●
Dell System 220	○	○	●	○	○
Dell System 310	○	●	●	○	○
Everex Step 386/25	○	●	●	○	●
IBM PC-AT Model 339	○	●	●	●	●
IBM PS/2 Models 60 & 80	○	○	○	●	●

● = Boots up ○ = Does not boot up

[a] From Software Development Kit version 1.03. [b] Both 16 and 20 MHz models.

Matching OS/2 to the hardware is more demanding than with DOS. A developer contemplating the move to the new system needs to determine which version runs on his machine or which machine can run a desired OS/2 version.

For development at this level, a language and compiler must be judged on their support of the protocols required by the API—the ability, for example, to pass arguments both by value and by far address. By no coincidence, OS/2 implements a stack-based API protocol identical to that of Microsoft compilers. (Articles covering various OS/2 compilers are scheduled for future issues of *PC Tech Journal*.)

Assemblers. Most applications development is done in high-level languages; in OS/2, even systems-level programming does not require resorting to an assembler. Still, assembly language code is useful for very low-level programs, such as device drivers, and for the best performance, as in high-speed communications programs. An assembler is therefore an integral part of a serious developer's toolkit.

Unlike a compiler, a DOS assembler does not need extensive conversion to be useful in OS/2. In fact, it does not even need to be ported to the new operating system—assemblies can be done in OS/2 real mode using any DOS assembler, as long as the resulting object files are linked in protected mode.

The drawback of using a DOS assembler is that real-mode programs are suspended when switched into the background. However, most assemblies are fairly short and can be completed in the time it takes to start up another task. Further, real mode can execute concurrently with a protected-mode task in the background, provided that the background task is started first.

For the utmost flexibility, however, a protected-mode assembler is useful. Two are currently available, the IBM Macro Assembler/2 and Microsoft MASM 5.1. The IBM product is based on Microsoft's MASM 4.0 and therefore does not include the MASM 5.0 enhancements such as simplified segment directives. The assembler is supplied as a family-mode application—the same .EXE file executes under DOS and either mode of OS/2.

MASM 5.1 comes in two versions, one a family-mode program, the other for real mode only. DOS users can load just the real-mode version and thus avoid the family-mode performance penalty (see "Family Ties," David A. Schmitt, June 1988, p. 124.) A protected-mode-only version is not necessary because a family-mode program incurs no performance penalty when running in protected mode. Tests indicate that under DOS, the real-mode version is faster by an insignificant 5 to 10 percent. On a system that runs both OS/2 and DOS, there is no point in keeping both copies.

Editors. A programmer spends more time editing source code than doing anything else, yet this activity grossly underuses the computational horsepower because the system spends most of its time waiting for the next keystroke. A multitasking editor permits overlapping this light load on other, more compute-intensive activities such as compiling and linking.

Although you can use a DOS editor in real mode, most such editors put too much load on the system by actively polling the keyboard instead of waiting for keyboard interrupts. As a result, any background processing slows to a crawl. Still, most programmers are so attached to their editors that they will endure this delay rather than switch to an unfamiliar protected-mode editor.

Presently, the choices in protected-mode editors are: Epsilon (a version of Emacs) from Lugaru Software, ME from Magma Systems, and the editors bundled with compilers from Lattice and Microsoft. An OS/2 version of Brief from Solution Systems has been announced for delivery later this year. As more programmers realize the potential of OS/2 for development, more editors will become available to support them in that environment.

Debuggers. Most language processors include a debugger of some sort, and OS/2 versions come with a protected-mode debugger. The three examined for this article were the IBM and Microsoft versions of CodeView and the Lattice C-Sprite debugger supplied with the Lattice C compiler.

Two special considerations are inherent to debugging under OS/2. First, protected mode normally isolates programs from each other, so a debugger must make special arrangements with the operating system to gain access to the address space of the program being tested. Second, programs can have more than one concurrent thread of execution, and the debugger should be able to monitor and control all of them. Of the three protected-mode debuggers examined, only one provided the second capability.

Although each is adequate for single-thread programs, only Microsoft's CodeView supports multiple threads. IBM has announced an updated CodeView with multithread capability that will be available in the fourth quarter of 1988 as part of its C/2 compiler version 1.1.

In the meantime, the capability of Microsoft's protected-mode CodeView is a compelling reason to choose its language processors over others. Unfortunately, the full power of CodeView remains out of reach—especially for source-level symbolic debugging—with non-Microsoft compilers because no other compilers produce the proprietary object-code information that CodeView requires.

Header files. For programming in C, header files that provide prototypes of the API functions are more a necessity than a convenience. Rather than simply providing a means of error-checking the number and types of function arguments, header files actually cause the generation of type conversions in the mixed-memory models commonly used in C programs for OS/2. For example, a program can reference its own data and functions according to the small model, but the system routines it calls are in far segments, and the pointers that it passes to those routines must be far addresses. The presence of function prototypes ensures that the compiler inserts the proper type conversions between local and system-level representations of variable and function addresses.

Each C compiler provides a set of header files; the IBM and Microsoft versions are also included in each manufacturer's toolkit. IBM provides only two files: one containing prototypes and structure declarations for all the API functions whose names begin with DOS, the other for KBD, MOU, and VIO functions. Lattice and Microsoft split the functions among more files, letting the programmer limit inclusion to a required subset. With IBM's method, referencing just one function in each header file requires including more than 81KB of header files. In many cases, processing the headers takes longer than compiling the source code itself.

One drawback to the Microsoft files is that declarations of function arguments use **typedefs**, not the standard C types. The **typedef** definitions themselves are spread over several of the header files, making it difficult to cross-reference their meanings. In some cases, the **typedef** names are obvious, such as USHORT for **unsigned short integer**, but in other cases, the meaning is more obscure, such as PSZ for a **char far** * pointer to a zero-terminated string.

IBM files use standard C key words and are much easier to read, which is fortunate because the contents of the IBM headers are not otherwise documented. Microsoft documents the names of data structures and the elements within them in the *Programmer's Reference* provided with its Programmer's Toolkit.

IBM, both in its Programmer's Toolkit and with the assembler, also provides include files for assembly-language programs. Again, two files are present, one for kernel functions, the other for subsystems. For each function, a macro generates an EXTRN statement, code to push arguments on the stack, and the call instruction. Unlike C header files, the assembly-language include files are not required or even helpful—quite the contrary, they can be hazardous to the health of a program. The instruction sequences

generated by these macros are incredibly inefficient, and coding the calling sequences by hand (or providing your own macros optimized to the requirements of each program) is well worth the minimal extra effort. For example, the most efficient code for calling DosChDir((char far *)path, 0L) is:

```
push  ds
push  offset path
push  0
push  0
call  DosChDir
```

The IBM macros load all arguments from memory locations and do not accept constants as arguments, so the programmer needs to define a variable, called **longz** in this example, containing a double-word zero. The macro for the DosChDir function generates the following code sequence:

```
mov   ax,SEG path
push  ax
lea   ax,path
push  ax
push  ds
push  bx
mov   ax, SEG longz
mov   ds,ax
mov   bx, OFFSET longz
push  word ptr [bx]
mov   ax,[bx + 2]
push  bp
push  sp
pop   bp
xchg  [bp + 6],ax
pop   bp
mov   ds,ax
pop   ax
pop   bx
push  ax
call  far ptr DOSCHDIR
```

This code sequence is by no means a worst-case example; functions with several double-word arguments fare even worse. Code like this defeats the very purpose of using assembly language, which is to optimize a program for both code size and speed. The bottom line is to throw away the IBM include files.

OS/2 linkers. An OS/2 linker is available from a variety of sources—it is included with the operating system, with both the IBM and Microsoft Programmer's Toolkits, and with language processors from IBM and Microsoft. As with DOS, the version that comes with Microsoft languages is more recent than the one bundled with OS/2 or with IBM languages. In all versions, the OS/2 linker is a family-mode program. It creates an executable file of the same mode in which it is running.

Besides its usual role of converting compiled object code to executable programs, an OS/2 linker can create dynamic link libraries (DLLs). Functions called from OS/2 programs need not be linked statically into the executable file at build time but can be linked dynamically at runtime. All of the OS/2 API functions are dynamically linked. In addition to smaller .EXE files, dynamic linking provides two major benefits. First, a program can be provided with new versions of called procedures without being recompiled, even without access to the program's source or object code. Second, a single copy of a dynamically linked routine can be shared by several concurrent programs.

Information on whether to build a program or a DLL is specified in a module definition (.DEF) file, which is

Compared with DOS, the cost of developing under OS/2 is still rather high, but then, not many of the good things in life come cheap.

processed by the OS/2 linker. This is a text file in which the programmer specifies various attributes of the program or DLL. Usage of .DEF files is documented in manuals provided with IBM and Microsoft language processors and in the IBM *OS/2 Technical Reference.*

When building an executable program, the linker must know which calls are to be resolved by static linking from an object module library and which are to be left unresolved for dynamic linking. One way of specifying this information is by naming the dynamically linked routines in **import** statements in the .DEF file. Maintaining .DEF files can become bothersome when the set of function calls changes during program development. Instead of specifying the changing needs of a program in a .DEF file, the programmer can specify the dynamic links available in a DLL in an import library. This information is invariant as long as the DLL is unchanged.

Import libraries are created by the IMPLIB program included in both the IBM and Microsoft toolkits. This utility processes a DLL and creates an output file with a .LIB extension and the structure of an object module library. Instead of object code, however, the import library contains records that identify all the dynalink (Microsoft's term for dynamic link) procedures in that DLL. The linker uses the import library along with regular object libraries to resolve external calls. Routines found in the object libraries are inserted into the executable file, but the routines from the import library are marked for dynamic linking.

The IMPLIB utility is useful only to programmers developing their own DLLs, and even then an import library is merely a convenience, not a necessity. In cases where the product consists of the DLL itself (for use by applications developed by the customer), however, an import library should accompany the DLL to facilitate the customer's development.

Microsoft language processors include a new linking utility called ILINK, an incremental linker that can replace only specified object modules in an .EXE file. For large programs of many modules, it can save significant time over a full rebuild, especially in the later stages of development when changes are being made to only a small number of modules.

An object module librarian comes with most compilers and with both the IBM and Microsoft toolkits. Like the linker, it is a family-mode application. The librarian is functionally equivalent to the DOS version. The MAKE utility is provided with language processors only, not the toolkits.

The message-building utilities MKMSGF and MSGBIND provided with each toolkit have no counterpart in DOS. These programs are not required for developing OS/2 applications but provide additional flexibility, especially in supporting multilingual applications.

To facilitate program output in a variety of natural languages, OS/2 provides a method of separating message text from other program data. Messages, consisting of a message number, a severity level, and the message text, are placed in a plain ASCII text file. MKMSGF converts such a text file into a .MSG file, placing an index by message number at its head.

An application retrieves a message by calling the DosGetMessage function and passing the message number, the name of a .MSG file, a pointer to a table of substitution strings, and the address of a buffer to receive the message text. Before placing the message into the buffer, DosGetMessage scans the message text for placeholders, identified (as in batch files) by the to-

FIGURE 1: *Example of API Documentation*

IBM OS/2 TECHNICAL REFERENCE

```
EXTRN DosFindFirst:FAR

PUSH@  ASCIIZ  FileName       ; pointer to filename pattern
PUSH@  WORD    DirHandle      ; directory handle (returned)
PUSH   WORD    Attribute      ; file attribute
PUSH@  OTHER   ResultBuf      ; buffer for file info
PUSH   WORD    ResultBufLen   ; length of info buffer
PUSH@  WORD    SearchCount    ; count of entries to find
PUSH   DWORD   0              ; reserved, must be zero

ResultBuf contains one or more instances of the following structure:

    WORD     File creation date
    WORD     File creation time
    WORD     Date last accessed
    WORD     Time last accessed
    WORD     Date last modified
    WORD     Time last modified
    DWORD    Length to end of data
    DWORD    Length allocated
    WORD     File attribute
    BYTE     Length of name string
    n BYTES  ASCIIZ file name string
```

MICROSOFT OS/2 PROGRAMMER'S TOOLKIT API REFERENCE

```
USHORT DosFindFirst( pszFileSpec, pdirhandl, usAttribute, pfindbuf,
                     usBufLen, pusSearchCount, ulReserved)

PSZ           pszFileSpec;      pointer to filename pattern string
PHDIR         pdirhandl;        pointer to directory handle
USHORT        usAttribute;      file attribute
PFILEFINDBUF  pfindbuf;         pointer to FILEFINDBUF structure
USHORT        usBuflen;         length of structure array
PUSHORT       pusSearchCount;   pointer to file count
ULONG         ulReserved;       must be 0L

typedef struct _FILEFINDBUF {
    FDATE  fdateCreation;
    FTIME  ftimeCreation;
    FDATE  fdateLastAccess;
    FTIME  ftimeLastAccess;
    FDATE  fdateLastWrite;
    FTIME  ftimeLastWrite;
    ULONG  cbFile;                 /* data length */
    ULONG  cbFileAlloc;            /* allocated length */
    USHORT attrFile;
    UCHAR  cchName;                /* length of file name string */
    CHAR   achName[13];
} FILEFINDBUF;
```

On the left, IBM's documentation defines API functions with a pseudocode that is similar to assembly language; it translates readily to other programming languages. On the right, Microsoft's documentation uses C-language syntax; translation to other languages is hindered by the use of nonstandard **typedefs** that are not documented except in the header files.

kens %0 through %9, and replaces each with a text string from the substitution table. Upon return from DosGetMessage, the calling program can write the message to a file or device with one of several output functions—for example, printf, DosPutMessage, DosWrite, or VioWrtTTY.

To avoid the overhead of opening and reading the message file, messages also can be bound into a program's executable file. MSGBIND extracts specified messages from a .MSG file, puts them into a data segment, and appends that segment to an .EXE file.

DosGetMessage looks for messages first in the message data segment and opens the message file only if no message segment exists or the message is not present. Binding messages to programs in this way provides more flexibility than coding messages directly into data segments, because incorporating changes in message text requires access only to the message file, not to the program source code.

BIND utility and API.LIB. Another set of tools specific to OS/2 is the BIND utility and associated API.LIB library. These tools are needed for building family-mode applications, not for protected-mode-only applications. A family-mode application runs (from the same .EXE file) in OS/2 protected mode, OS/2 real mode, and under DOS. Such a program is written using the family-mode subset of OS/2 API functions, then compiled and linked as a protected-mode .EXE file. It is converted to a family-mode program by BIND, which appends to the .EXE file a stub loader and real-mode routines from API.LIB that have the same the program interface as the OS/2 functions.

If the program is loaded in protected mode, the OS/2 loader discards the interface routines and dynamically links to protected-mode procedures. In real mode, the stub loader links the program to the interface routines.

Documentation. A programmer's toolkit is useless without documentation of the API. Microsoft includes an API function reference in its package, which costs $350 complete; IBM does not include API documentation but instead offers a separate *OS/2 Technical Reference* for an additional $200, raising the total price of its package to an exorbitant $950. For that price, IBM includes reference documentation and some instructional material on device drivers, plus a free upgrade to version 1.1 when Presentation Manager is released. These extras still do not justify the high price—the Microsoft toolkit is, for most purposes, a better value, even if developers have to pay another $350 for a version 1.1 of that toolkit.

Microsoft's *Programmer's Reference* is a single volume of 580 pages with the bulk of it covering the API and IOCTL functions. Appendixes describe systems-level utility macros that are supplied with the C 5.1 compiler, the structure and function of code pages for implementing foreign character sets, and the structure of OS/2 .EXE files.

IBM's *OS/2 Technical Reference* is a two-volume set of about 1,300 pages. Volume 1 describes the API functions in functional groups, providing more information about each group than the Microsoft manual, which merely lists the functions by group. The IBM manual also gives information on the architecture of device drivers, a reference to device-driver commands and Device Help services, and descriptions of the standard system device drivers for the hard-disk and diskette drives, keyboard, screen, clock, serial port, printer, and RAM disk. (For a discussion of device drivers, see "Designing Drivers for OS/2, Parts 1 and 2," David A. Schmitt, December 1987, p. 164 and February 1988, p. 136.) Volume 2 of the IBM manual is a reference to the API and IOCTL functions.

The examples of API documentation shown in figure 1 reveal the differences in the IBM and Microsoft references. The IBM manual gives the calling sequences in a pseudocode that is similar to assembly language, while Microsoft gives them in C. In the Microsoft manual, the names of struc-

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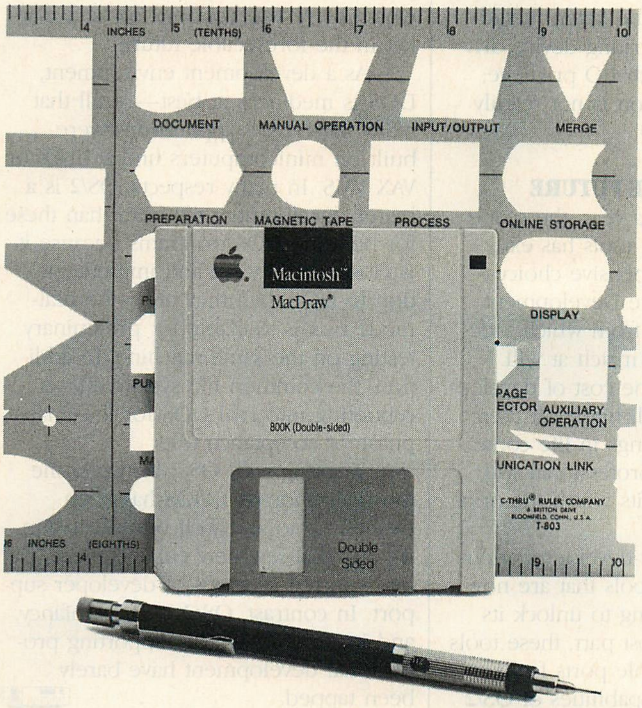

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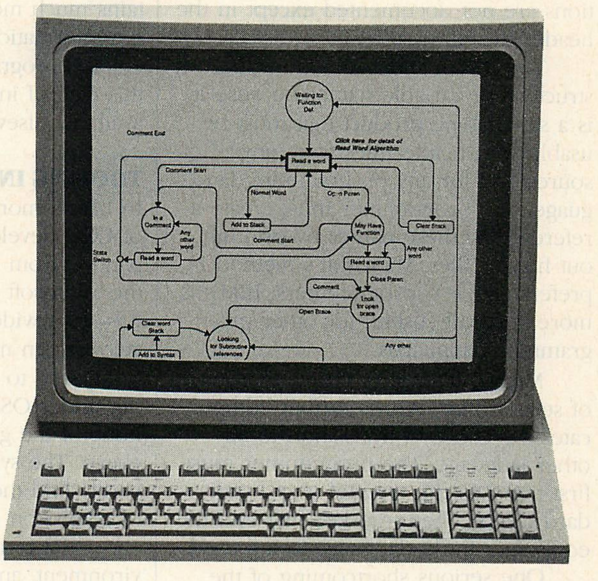

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tures and their elements are the actual names used in the C header files supplied with the Programmer's Toolkit and the C 5.1 compiler. However, the **typedefs** used in the variable declarations are not documented except in the header files themselves.

The IBM manual uses no actual structure or variable names because it is a stand-alone product that must be usable with header files from any source and for any programming language. The programmer must create a reference to these names by printing out header files. Microsoft's method is preferable for C programmers; IBM's is more generally useful for other programming languages.

Microsoft's use of **typedefs** instead of standard key words further complicates the chore of translation to another language. The programmer must first translate the **typedef** into a standard C type, then translate that into the equivalent in the language being used.

One serious shortcoming of the IBM manual is that it does not specify the possible errors for each function. When implementing error recovery, the programmer must peruse the list of errors in an appendix, looking for those that are likely to occur for a given function.

Each of the toolkits contains a slim manual describing the operation of the various build utilities and containing some instructional material on programming for OS/2. IBM's manual contains much more of the latter, including information on writing device drivers and programs with I/O privilege; this type of information is not readily available elsewhere.

TOOLING INTO THE FUTURE

In barely more than a year, the scope of OS/2 development tools has expanded from one expensive choice—the Microsoft Software Development Kit—to a wide array from which a developer can mix and match at will. Compared to DOS, the cost of developing under OS/2 is still high, but then, none of the good things in life come cheap. The systems professional will surely find the benefits worth the price of admission.

OS/2 is a terrific development environment, and the tools that are now available are beginning to unlock its potential. For the most part, these tools were created by simple ports from DOS; even so, the capabilities of OS/2 make them several orders of magnitude more useful than they were in their former incarnations.

Migrating development activities to OS/2 need not be predicated on widespread acceptance of OS/2 applications, because OS/2 is an ideal development platform for DOS applications, for which there will continue to be a market in the foreseeable future.

As a development environment, DOS is mediocre at best—recall that many large DOS applications were built on minicomputers under UNIX or VAX VMS. In many respects, OS/2 is a better development platform than these for building DOS programs because it is closer in concept and implementation to DOS than they are—the real-mode box is available for preliminary testing on the same machine. In addition, the common file system allows rebooting into real DOS for the final phase of acceptance tests.

Working with OS/2 brings home the realization that DOS has been pushed up to and well beyond its limits, and that few new enhancements can be expected in terms of developer support. In contrast, OS/2 is in its infancy, and its capabilities for supporting professional development have barely been tapped.

Ted Mirecki is a technical editor for PC Tech Journal, *specializing in systems software.*

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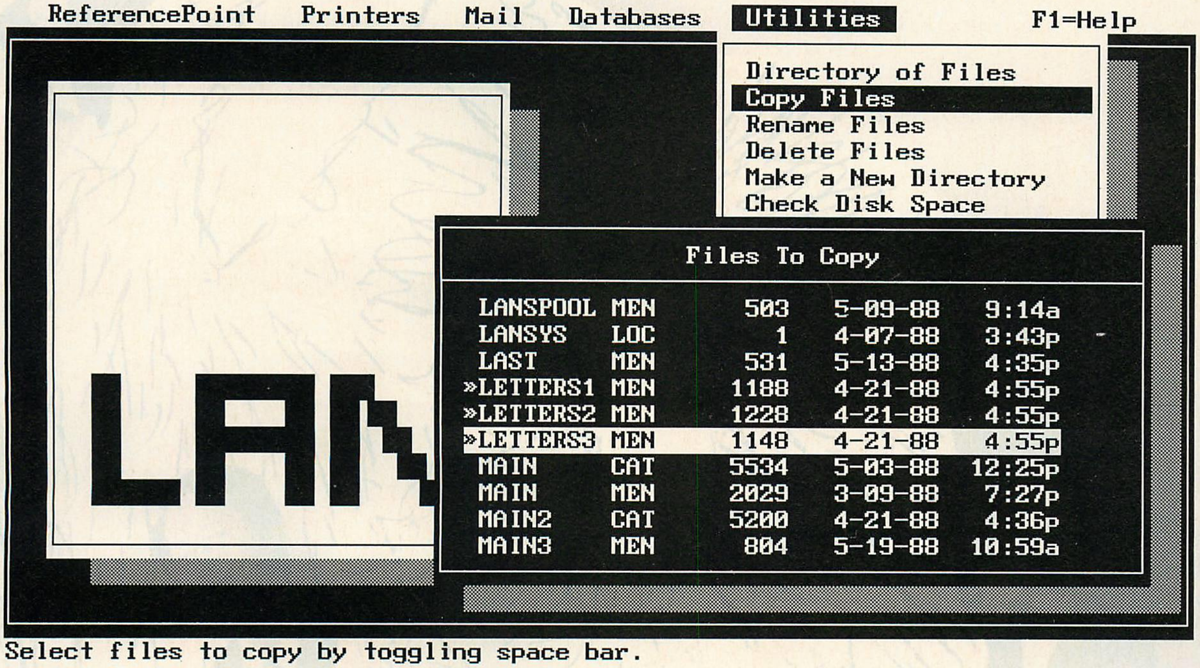

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386

COMPATIBILITY

PERFORMANCE

The AST Premium/386, built around the multimaster SMARTslot architecture, tries to bridge the gap between the classic AT bus and IBM's Micro Channel. Can still another architecture compete in the 386 market?

AST's Smart Machine

DAVID CLAIBORNE

AST Research has specialized in making good products work even better, first with PC expansion boards and now as a computer manufacturer. The company proves once again that there is always room for improvement—this time, it is the classic AT bus. With its new SMARTslot architecture, AST's Premium/386 provides multimaster capability while remaining fully compatible with the 8/16-bit AT bus. The computer's 20-MHz 80386 Intel microprocessor yields plenty of speed, and a dedicated memory bus provides 32-bit, 20-MHz communication between 13MB (maximum) of static-column memory and the CPU.

The Premium/386 is not a clone computer assembled from parts purchased from various vendors; the unit is wholly designed and manufactured by AST. The system board includes a diskette controller, two serial ports, a parallel port, and Intel 80287 and 80387 math coprocessor sockets. This level of system-board integration ensures that maximum performance is derived from each component. It also means that the Premium/386 is relatively expensive (see sidebar). The Premium/386 reviewed costs $10,180, compared with $11,710 for a similarly equipped 20-MHz IBM PS/2 Model 80 with a 115MB hard disk and $11,515 for a 20-MHz Compaq Deskpro 386/20 with a 100MB hard disk.

The Premium/386's SMARTslot architecture is an innovative enhancement of the AT standard. While not quite as capable as IBM's Micro Channel Architecture, introduced with the PS/2 models, it does provide one of the most important features—multimaster bus control. Like Micro Channel, SMARTslot architecture is a technology waiting for an application. As OS/2 and UNIX become more prevalent on personal computers, however, bringing with them multitasking and multiuser requirements, multimaster bus control will become increasingly important.

AST is providing the complete SMARTslot specification and a royalty-free license to all comers, thereby providing the personal computer industry with a no-cost means of implementing multimaster bus control within the current AT standard. The only requirements that AST puts on this release are that devices using the architecture must "prominently" display the SMARTslot trademark and that the devices be certified by a testing agency designated by AST to ensure the device does indeed comply with the SMARTslot architecture.

SMARTSLOTS AND MORE

AST has taken a bold step in introducing the SMARTslot architecture as an alternative to IBM's sophisticated Micro Channel. Even so, more than 300 companies have requested the complete specification, says AST, indicating a definite interest in next-generation bus architectures other than IBM's.

The original IBM PC data bus is designed so that all communications between expansion boards and system memory passes through the CPU, an Intel 8088 in the case of the PC. Because of the 8088's 8-bit data path, the data path of the expansion bus is also 8 bits wide. When IBM introduced the PC/AT, it introduced a new 16-bit bus

PHOTOGRAPHY • MARC DAVID COHEN

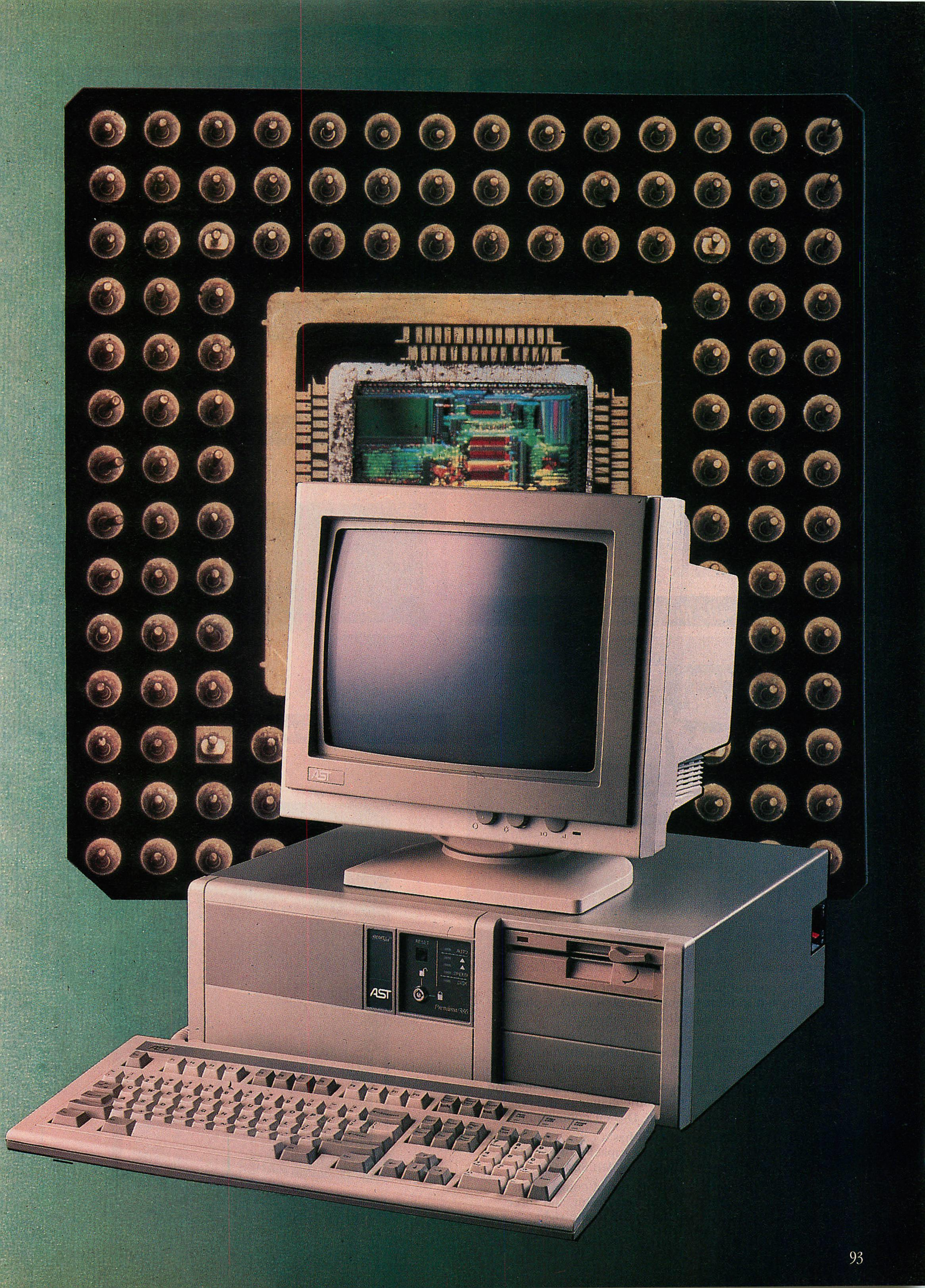
AST
RESET
Premium/386

PHOTO 1: ***System Unit***

PHOTO 3: ***Rear of the System Unit***

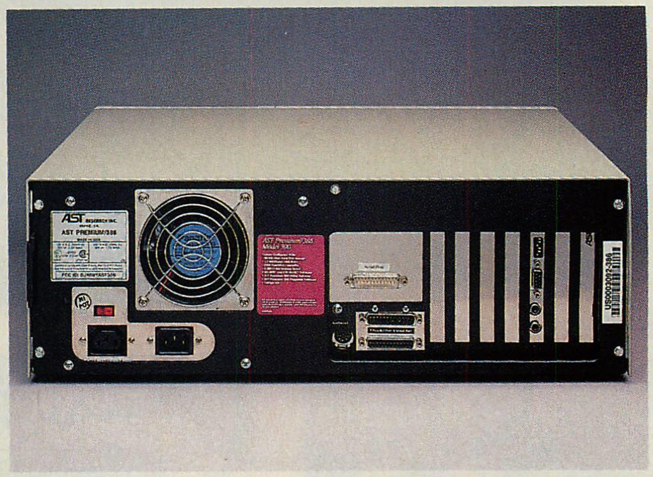

PHOTO 4: ***System Memory Board***

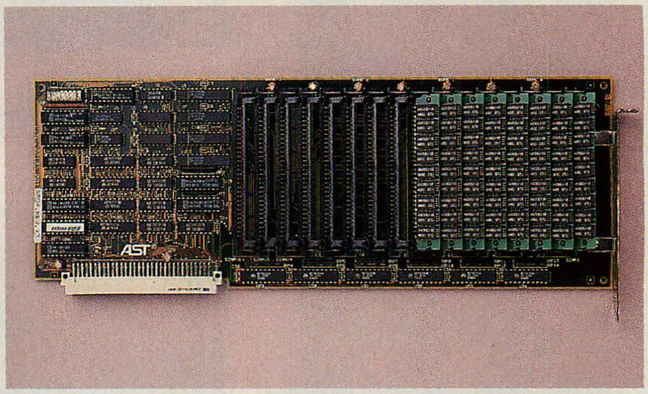

PHOTO 2: ***Inside the System Unit***

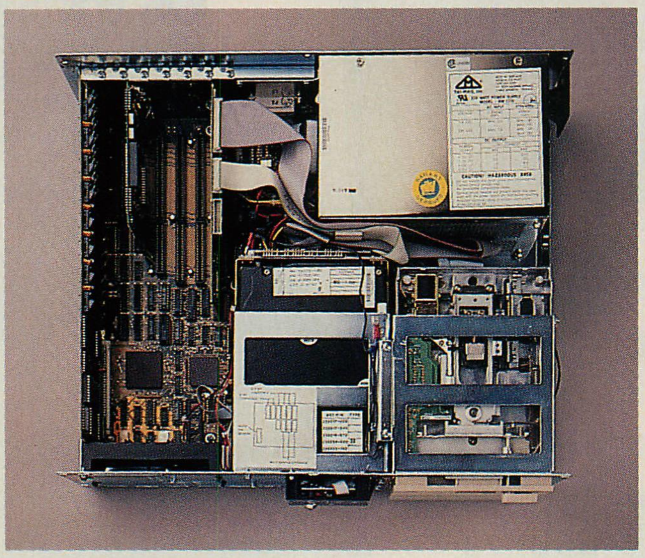

PHOTO 5: ***System Board***

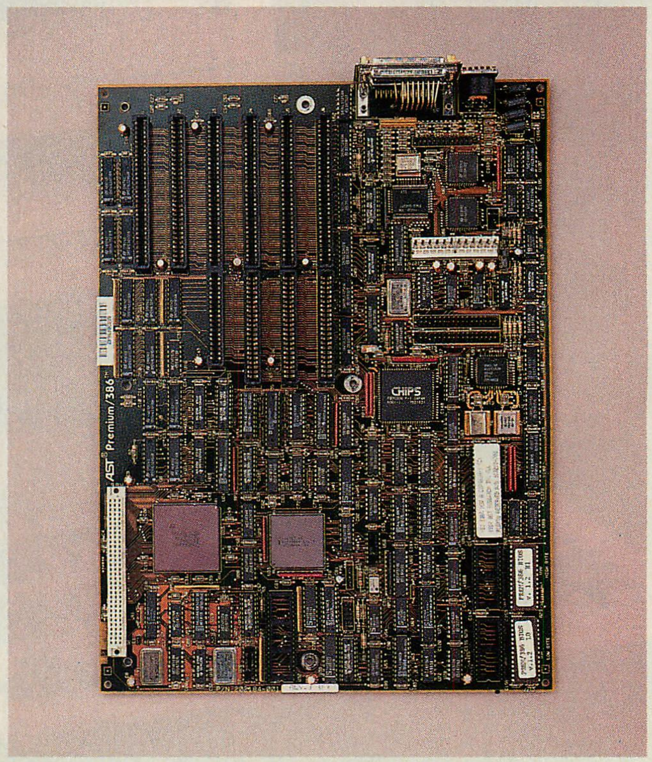

Photo 1: The control panel containing the key-lock switch, reset button, and indicator lights can be rotated to allow the system to be used vertically or horizontally.

Photo 2: The review unit uses a half-height 90MB hard disk. The hard-disk controller is installed in the right-most AST SMARTslot. The system memory board is on the far left.

Photo 3: Connectors for the system board's one parallel and two serial ports are mounted near the center of the rear panel. The serial ports have 25-pin, D-shell connectors.

Photo 4: The system memory board has a capacity of 13MB. The first four SIMMs installed have a capacity of 256KB each, the remainder can be 256KB or 1MB SIMMs.

Photo 5: The 96-pin system memory board connector is mounted to the left. The two 8-bit, one 16-bit, and three SMARTslot bus connectors are mounted to the right.

with a signal called MASTER that allows direct memory access (DMA) between devices on the bus and the computer memory. Arbitration is performed through a DMA controller, and data throughput is achieved by interleaving bus control with the CPU. This interleaving, however, reduces the effective bandwidth for DMA transfers.

With the Micro Channel, IBM abandoned the AT bus entirely for a new structure that allows DMA transfers to be controlled by devices other than the CPU. A board in a Micro Channel slot can be granted control of the bus and can communicate directly with system memory, allowing multiple processors to exist within PS/2 computers. The additional processors can be full-blown computers or special-purpose processors dedicated to specific tasks that normally require substantial CPU time, such as graphics adapters, communications devices, or disk controllers. On the Models 50 and 60 Micro Channel boards can perform 8- and 16-bit data transfers; on the Model 80, boards in 32-bit slots can perform 8-, 16-, or 32-bit transfers.

The SMARTslot bus is identical to the AT bus except for four pairs of connectors added to the front-panel end of the standard AT bus connector. SMARTslot architecture allows up to four masters (the CPU and three SMARTslot devices) to control the bus. Figure 1 shows the conceptual arrangement of the architecture.

Three of the eight new pins on the SMARTslot connector are reserved for future use. The other signals are MASTER16, MASTER8, BUSREQ, BUSGNT, and BUSBSY. MASTER16 and MASTER8 are access signals that identify the data-width capability of the controlling master. They are used by other standard AT status signals to control the steering logic on the system board. MASTER16, when asserted, identifies the controlling master as capable of 8- or 16-bit accesses. The master identifies the transfer by the standard system bus high enable (SBHE) and address bit 0 (SA0) signals. MASTER8 identifies the controlling master as capable of only 8-bit accesses. The appropriate byte is identified by SA0.

A bus master generates BUSREQ to indicate it wants control of the data bus. BUSREQ stays asserted until the master no longer needs the bus, allowing for sustained burst transfers. Arbitration circuitry on the system board generates BUSGNT, which indicates that the master has been granted bus access. The leading edge of the signal acknowledges a grant to the master, while the trailing edge identifies a request to release the bus. Once the master is granted permission by BUSGNT, it asserts BUSBSY to indicate that the bus is in use. The master continues to assert BUSBSY until BUSREQ is removed. The deassertion of BUSBSY acknowledges that the master has released the bus.

AST-designed circuitry on the system board performs arbitration. (See figure 2 for a block diagram of the arbiter.) To reduce the complex circuitry, AST provides only three SMARTslots. The design requires each SMARTslot arbitration signal to go to the arbiter circuit, along with signals from the CPU, DMA controller, and system board refresh circuit. The arbiter also has an arbitration block (ARBBLK) signal used to block arbitration until a "critical" section of code is completed—for example, a high-speed timer tick where interrupts cannot be lost.

The SMARTslot preemptive priority scheme is simple. When a master in a SMARTslot wants the bus, it asserts BUSREQ. As long as the other masters (the CPU or other two SMARTslots) do not have control, it will be granted the bus. If another master has the bus, the master seeking control must wait. This arrangement requires some cooperation so no one master grabs the bus and holds on indefinitely. AST recommends that developers limit bursts to 64 words or less, at which time the master should give up the bus.

The AST arbiter forces a SMARTslot master to relinquish the bus when the arbiter receives a DMA or memory-refresh request. Once the higher priority operation is completed, bus control is returned to the interrupted master.

In comparison, bus arbitration on the Micro Channel is more complex (for a full explanation, see "An Architecture Redefined," David Methvin, August 1987, p. 58) and uses a 16-level, preemptive-priority scheme. Each device on the Micro Channel bus has a preassigned priority and must sense the priorities of the other devices requesting the bus. The highest priority device at the beginning of each bus cycle takes control of the bus. An optional "fairness" feature prevents one device from usurping too many bus cycles. Nonmaskable interrupts (NMI) and refresh requests take priority over all other requests.

Although AST and IBM achieved multimastering with distinctly different architectures, they reached the same conclusions for improving memory performance. Of the many different schemes available, AST chose the static-column (or page-mode) method with a 2KB page, the same addressing scheme used in the 20-MHz IBM PS/2 Model 80 (see "Model 80 Flagship," Kent Quirk, April 1988, p. 62). It produces zero-wait-state memory accesses within the current page, while accesses outside the page require two wait states. Though average performance is not as fast compared with a memory-

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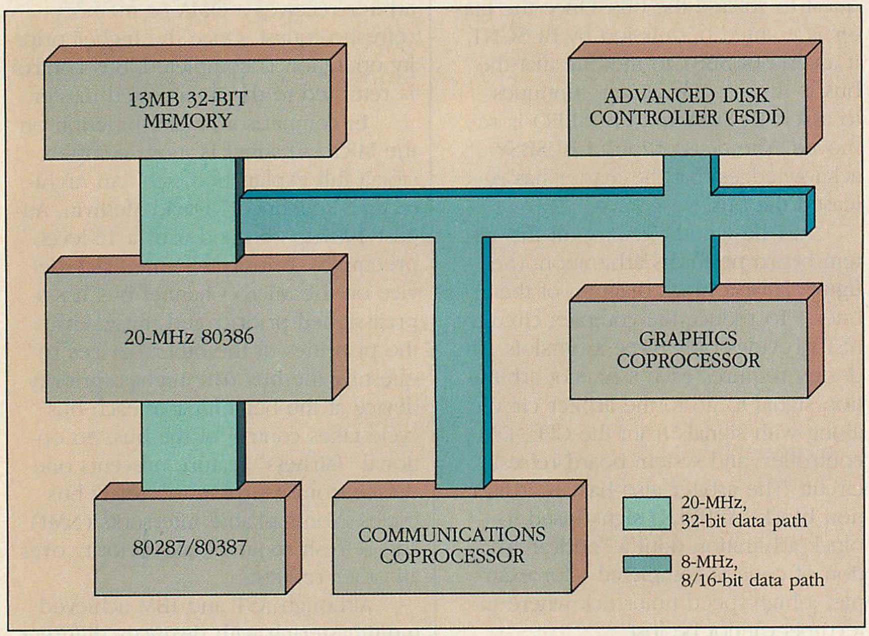
360KB diskette drive: $215
1.2MB diskette drive: $245
1.44MB, 3.5-inch diskette drive: $235
*MS-DOS 3.3: included
*GW-BASIC 3.3: included
MS-OS/2 1.0: $325

*An asterisk (*) indicates the model reviewed and the options included. The announced retail price of that model with those options is $10,180.*

FIGURE 1: *SMARTslot Architecture*



The Premium/386's CPU accesses system memory using a 20-MHz, 32-bit bus; other processors on optional expansion boards can communicate with system memory using the 8-MHz, 8/16-bit AT-compatible SMARTslot arbitration bus.

cache scheme based on the Intel 82385 cache controller used in the Deskpro 386/20 and others, it is still very quick (see "Full Speed Ahead," David Claiborne, March 1988, p. 90).

Besides the SMARTslot and static-column memory architecture, the Premium/386 incorporates other features to make the programmer's job a little easier. System setup is controlled by the AST Setup Utility, which hides in the background as long as the devices in the system unit correspond to what it has stored in memory. If the program detects a difference when the system is booted, it flashes a message that the setup parameters do not match the system components. Pressing F1 continues the start-up process, ignoring the error message. Pressing Ctrl-Alt-Esc invokes the ASTSETUP program.

ASTSETUP consists of two screens of information. All of the configuration choices (with the exception of date and time) are selected by stepping through a stored set of values. Table 1 lists the parameters (with the available options) set by the utility.

The Auto Slowdown feature ensures compatibility with AT software. When enabled, the system automatically slows from 20 MHz to 8 MHz when a diskette drive is accessed, allowing the Premium/386 to load programs that use time-critical copy-protection schemes. Auto Slowdown takes effect only if the system speed is 20 MHz.

To improve system performance, AST includes a Shadow RAM feature with the Premium/386. The first 1MB of memory in the Premium is divided into two parts, 640KB of conventional memory and 384KB of reserved memory. The system ROM is copied into the first 128KB of the reserved memory. Calls to ROM are then processed over the 20-MHz, 32-bit bus.

PLENTY OF ROOM

The Premium/386 uses the same size system-unit enclosure as the Premium/286 and can be used vertically or horizontally (see photo 1). Although it is slightly smaller than the IBM AT and the Compaq Deskpro series, the Premium/386 has ample room for a full configuration of storage devices, including three externally accessible half-height bays and one internal full-height bay. The system's 220-watt power supply makes it possible to fill up all these spaces with storage devices and still have power for an assortment of expansion boards (see photo 2).

The unit tested, the Model 390, uses a half-height 90MB drive, leaving half of the internal bay open. Although five half-height storage devices theoretically could fit into this computer, power connectors are provided for only four devices. The hard-disk controller can control two hard disks, but the data cable is provided for only one disk. The system is cabled to support two diskette drives (5.25- or 3.5-inch) from the controller integrated into the system board. An additional system board connector allows the installation of a third diskette drive. Tape drives that use diskette controllers also can be installed and controlled using the system board controllers.

The keyboard uses the enhanced 101-key IBM layout, but with some added touches. The key caps for the home keys, F and J, are scooped out slightly more than the other keys, allowing you correct finger positioning by touch. The key caps on the Ctrl and Alt keys and the lower row of auxiliary arrow keys are recessed and sloped back slightly from the angle of the rest of the keyboard. This reduces the chance of inadvertently pressing Ctrl or Alt when resting your hands on the edge of the keyboard. The keys have a good, stiff feel, but with no audible feedback when a key is pressed.

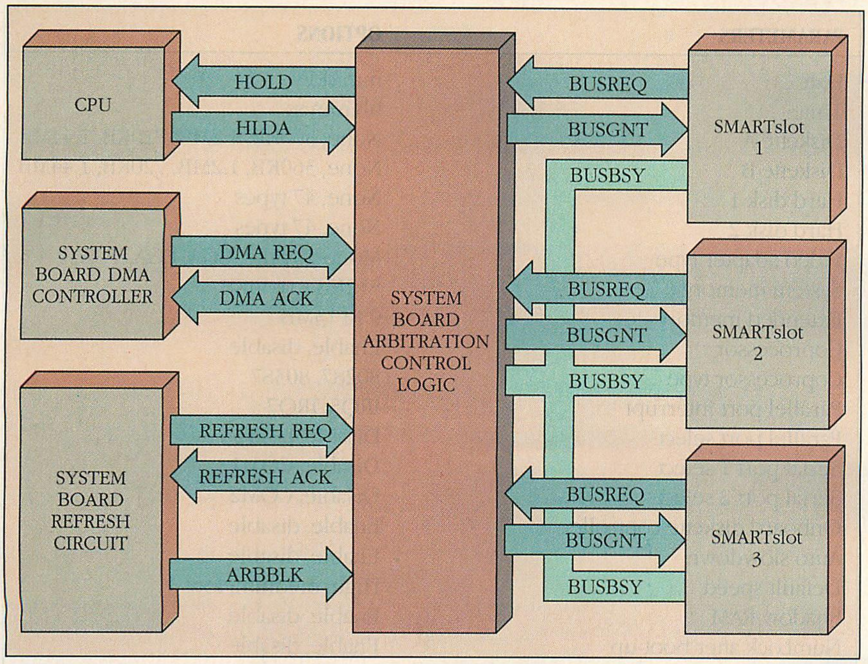
The control panel, which contains the key-lock switch, reset button, and indicator lights, is located in the center of the front panel and can be rotated 90 degrees so that the system unit can be used vertically or horizontally. This is an improvement over the Premium/286 where the control panel is located on the far left side of the front panel and is difficult to reach when the system is used vertically (see "Premium/286," Steven Armbrust and Ted Forgeron, June 1987, p. 74). Even the AST logo next to the control panel on the 386 machine rotates 90 degrees.

The key-lock switch does not lock the system unit cover but electronically disables the keyboard. The speed of the system (indicated by lights on the front panel: High = 20 MHz, Medium = 8 MHz, or Low = 4.77 MHz) can be changed easily by pressing Ctrl-Alt and the up or down arrow key to increase or decrease the speed. The panel also indicates whether the Auto Slowdown mode is enabled. Wait states are inserted to change speed rather than changing the clock rate, allowing the CPU to operate at full speed.

The reset button restarts the system even when it is stuck and will not respond to Ctrl-Alt-Del. The reset button has the same effect as a power down and up, except that power is not actually cut off. The full power-on system test (POST) is performed, and all memory is cleared and checked. The button is recessed so it will not be pushed inadvertently.

The Premium/386's system board has one parallel and two serial ports. Their connectors are mounted horizon-

FIGURE 2: ***SMARTslot Arbiter Circuit***



A SMARTslot board requests control of the bus by asserting BUSREQ. If the bus is busy, the board must wait until it becomes available. A SMARTslot board must release the bus when the arbiter receives a DMA or memory refresh request.

tally on the back of the system case (see photo 3). The parallel port uses the standard IBM 25-pin, female D-shell connector. Both serial ports use a 25-pin, male D-shell connector, rather than the 9-pin type found on the IBM AT. Providing both 25-pin and 9-pin connectors would be more flexible.

EASY CONFIGURATION

System configuration is controlled by ASTSETUP, contained in ROM, and is invoked by booting the computer and holding down a key so the keyboard POST will detect an error. When the error is reported, the user invokes ASTSETUP by pressing Ctrl-Alt-Esc.

ASTSETUP also can be run from the utility diskette. All configuration options, with the exception of date and time, are stored in memory. One system parameter is not controlled by ASTSETUP. A small switch located inside the unit on the top of the control panel indicates whether the default display is color or monochrome.

The ESDI disk controller and the AST memory board have additional factory-set configuration switches. The AST *User's Manual* has instructions for changing the settings on the memory board, but instructions are not available for the disk controller.

System memory is contained in a single board located to the far left of the system board (see photo 4). The board is socketed for four banks of four single in-line memory modules (SIMMs). The first four SIMMs must use 256KB SIMMs, resulting in 1MB of memory, while the remaining can be 256KB or 1MB. They must be installed in sets of four, and all SIMMs in a set must be the same size. The net result is a 13MB memory capacity. Based on current AST memory prices—$595 for four 256KB SIMMs and an incredible $7,995 for four 1MB SIMMs—most people will probably not expand their system beyond 4MB.

To install the SIMMs, the memory board must be removed from the unit. Special care is required because the memory board uses a 96-pin connector, not an edge connector. The memory board has one set of eight switches to indicate the type of SIMMs (none, 256KB, or 1MB) installed in each bank. Only an AST-supplied SIMM is listed as acceptable for the Premium/386. AST uses 80-nanosecond static-column RAM chips in its SIMMs.

Installing diskette drives in the right-hand bay is easy because these bays are accessible from the front of the system unit. After the cover is removed, the additional drives are slid into one of three bays and secured.

The left-hand bays present more problems than the right-hand side because these drive bays have no external access. You must unscrew the disk cage

and lift it out of the system unit in order to install the new disk drive. Then you have to lower the cage back into the system unit and screw it back down. (It helps to have long, thin fingers.) To operate the hard disk, an additional ribbon cable with 20-pin connectors on both ends (usually provided with the hard disk) is required.

The Premium/386 accepts either an 8-MHz 287 or a 20-MHz 387 math coprocessor. Sockets for both are located in an easily accessible area in front of the expansion slot connectors (see photo 5). As long as you install the math coprocessor before you fill up the expansion slots, the installation is easy. Installing a coprocessor afterwards requires removing whatever expansion boards cover the appropriate socket. The system configuration is notified of the new coprocessor by running ASTSETUP.

The system board itself is well laid out and relatively uncluttered because of the use of many application specific integrated circuits (ASICs), including the ubiquitous Chips and Technologies AT/386 CHIPSet.

The unit has seven expansion slots that are very close together (only 13/16 of an inch between each slot) and the front slot guide is permanently attached to the case. These two factors make installation of some full-length boards an exercise in careful persuasion.

One expansion slot is dedicated to holding the system memory on a proprietary AST board using a 96-pin connector. Two slots feature the standard PC 8-bit bus connector. One slot has the standard 16-bit AT bus connector. The remaining three slots use AST's SMARTslot connector.

In a standard unit, one of the 8-bit slots is occupied by a video control card. The hard-disk controller occupies either SMARTslot closest to the disk drives. This leaves four slots—one XT, one AT, and two SMARTslots—available for network cards, tape-drives, mouse controllers, internal modems, and the like. Standard AT expansion boards can be used with the two available SMARTslot connectors as well as with the one 16-bit AT bus connector.

Two types of hard-disk controllers are available with the Premium/386: a standard ST-506 hard-disk controller for the 40MB hard-disk drive and a Western Digital enhanced small device interface (ESDI) controller for the larger 90MB and 150MB drives. The ESDI controller features a 16KB cache and uses a 1:1 disk interleave. Both controllers can control two disk drives.

TABLE 1: ***Setup Parameters***

PARAMETERS	OPTIONS
Date	mm/dd/yy
Time	hh:mm:ss
Diskette A	None, 360KB, 1.2MB, 720KB, 1.44MB
Diskette B	None, 360KB, 1.2MB, 720KB, 1.44MB
Hard disk 1	None, 47 types
Hard disk 2	None, 47 types
Video adapter type	Monochrome, CGA, EGA, VGA
System memory	512KB to 640KB
Extended memory	0 to 13MB
Coprocessor	Enable, disable
Coprocessor type	80287, 80387
Parallel port interrupt	IRQ5, IRQ7
Parallel port select	Disable, LPT1
Serial port 1 select	Disable, COM1
Serial port 2 select	Disable, COM2
Onboard diskette controller	Enable, disable
Auto slowdown	Enable, disable
Default speed	High, medium, low
Shadow RAM	Enable, disable
NumLock after boot-up	Enable, disable

Configuration choices other than date and time are selected by stepping through a set of stored values; 47 disk types can be specified using ASTSETUP.

For multitasking environments such as UNIX or OS/2, AST plans to provide the AST Advanced Disk Controller (ADC) at the end of 1988. The ADC may be the first SMARTslot expansion board available for use in the Premium/386—it will contain its own microprocessor and 64KB of RAM for track buffering.

SWIFT SOFTWARE

AST provides two diskettes of system utilities that substantially enhance the performance of the Premium/386. ASTMENU, the primary utility program, loads automatically when the system is booted from disk 1 of the AST utility software and presents a menu with five options: run the system setup program (ASTSETUP), run the system diagnostics (386TEST), install the utility software (ASTCACHE, ASTEMM, FASTDISK, FASTEGA, and SUPERSPL), format a hard disk, or return to DOS.

Running ASTSETUP (the same program that is stored in ROM) from the utilities diskette (version 3.3) caused the system to hang and locked the keyboard during testing. The front panel reset button restarted the system. This problem was corrected in version 3.4 of the utilities programs. When you exit ASTSETUP after making changes, the system reboots and clears the memory. You can return to ASTMENU if no changes are desired.

The diagnostics program, 386TEST, like IBM's Advanced AT diagnostics, can only be run from the diskette (option 2 from ASTMENU). If you attempt to run 386TEST from the hard disk, the system hangs as it begins to check the system memory, requiring a cold reboot.

Unlike the Advanced AT Diagnostics, 386TEST is only a superficial test of the Premium/386 because it does not include keyboard, math coprocessor, or graphics display tests, nor provisions for using loop-back devices to check parallel and serial ports. The 386TEST executable code has the message prompts for all these tests and more, but the options are not available to the user. When asked, AST confirmed that 386TEST is strictly a confidence test and not a diagnostics tool. The advanced diagnostics have been disabled in the commercial version.

The lack of a good diagnostics checkout of the system is a definite shortcoming in the Premium/386. Unless AST provides additional information on how to use 386TEST, you will be forced to depend on AST and your dealer to check out the system.

The ASTCACHE, ASTEMM, FASTDISK, FASTEGA, and SUPERSPL utility programs give a good boost to system performance. ASTMENU installs or removes all five and automatically makes the necessary changes to the CONFIG.SYS and AUTOEXEC.BAT files.

As you use the AST utility to install and remove the options, you must keep track of where you have allocated memory. As individual options are configured, ASTSETUP does not check for memory conflicts. When you try to save a new configuration, however, a check is made. Memory that has been doubly assigned, to a disk cache and a RAM disk for example, is indicated. You must go back to the individual utilities and change the configurations to remove the conflict.

ASTEMM is essentially the extended memory manager program developed and sold by Qualitas Inc. under the name 386-to-the-Max (see Product Watch, Steven Armbrust, December 1987, p. 197) and allows extended memory to be used as expanded memory. The expanded memory created with ASTEMM is fully compatible with version 4.0 of the Lotus/Intel/Microsoft expanded memory specification (EMS), allowing up to 32MB of expanded memory, limited only by the amount of memory installed in the system. ASTEMM is a protected-mode memory controller. This means that other software that wants to control the 386 protected mode (for example, Microsoft Windows/386) will not load if ASTEMM is loaded already.

ASTCACHE is a very flexible disk-caching program that uses conventional, expanded, or extended memory to improve disk access speed substantially. It was developed for AST by Multisoft Inc., the makers of Super PC-Kwik Disk Accelerator (see Product Watch, Ted Mirecki, August 1987, p. 211). In addition to the initial setup, ASTCACHE can be used with several parameters from the DOS prompt to alter the use of the cache when the system is operating. You can turn the cache on and off for different software program requirements.

You can create one or two RAM disks and a print spooler by using FASTDISK and SUPERSPL, two programs originally created for AST memory-board products. Both programs can use conventional, extended, or expanded memory.

FASTEGA transfers the EGA BIOS from the EGA card to 32-bit memory. This allows EGA BIOS calls to be executed from high- speed 32-bit, static-column RAM rather than from the 8-bit ROM on the EGA card. According to AST, FASTEGA can boost the speed of graphic operations by 50 percent.

The disk format option provides access to three programs: HDFORMAT, FDISK, and FORMAT. HDFORMAT, an AST program, performs a low-level format of a hard disk. FDISK and FORMAT are standard Microsoft programs to partition and format a hard disk for DOS. Partitions cannot be greater than 32MB. MS-DOS 3.3 (contained on two diskettes) is standard with the Premium/386. GW-BASIC also is included.

The Premium/386 comes with two volumes of documentation, *Operating System* and *User's Reference*, both professionally produced packages. All manuals are liberally illustrated and contain many tables.

The hardware section in the *User's Reference* provides adequate information, including pin-out lists for the external ports, for setting up a new system, and for installing optional devices. AST includes a two-page description of the SMARTslot architecture, but it does not include any information on SMARTslot pin outs, signal requirements, or arbitration schemes.

The information contained in the two volumes is adequate for setting up and running the Premium/386. It is equivalent to what IBM and Compaq

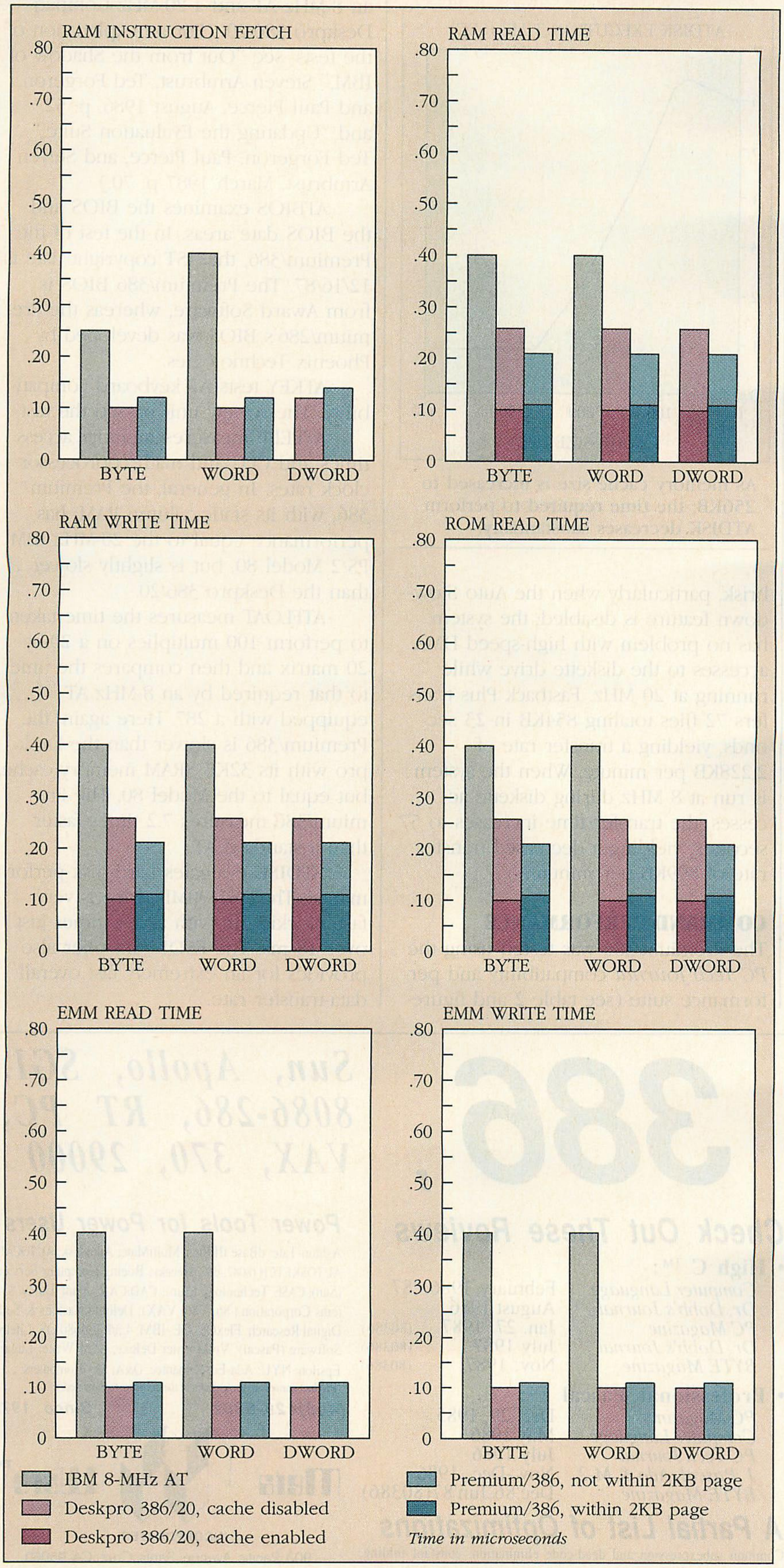
TABLE 2: *Compatibility and Performance Tests*

	8-MHz IBM PC/AT 80287, 30MB DISK[a]	20-MHz COMPAQ DESKPRO 386 80387, 300MB DISK	20-MHz AST PREMIUM/386 80387, 90MB DISK
ATBIOS			
ROM BIOS date	11/15/85	09/23/87	01/15/88
ATPERF			
Average RAM instruction fetch (μs)			
BYTE	.25	.10 (250)[b]	.12 (208)
WORD	.403	.10 (403)	.12 (341)
DWORD	N/A	.12	.14
Average RAM read time (μs)[c]			
BYTE	.401	.10/.26 (401/154)	.11/.21 (369/191)
WORD	.401	.10/.26 (401/154)	.11/.21 (369/191)
DWORD	N/A	.10/.26	.11/.21
Average RAM write time (μs)[c]			
BYTE	.401	.10/.26 (401/154)	.11/.21 (375/191)
WORD	.401	.10/.26 (401/154)	.11/.21 (375/191)
DWORD	N/A	.10/.26	.11/.21
Average ROM read time (μs)			
BYTE	.401	Same as RAM read	Same as RAM read
WORD	.401	Same as RAM read	Same as RAM read
DWORD	N/A	Same as RAM read	Same as RAM read
Average EMM read time (μs)[d]			
BYTE	.402	.10 (402)	.11 (369)
WORD	.402	.10 (402)	.11 (369)
DWORD	N/A	.10	.11
Average EMM write time (μs)[d]			
BYTE	.402	.10 (402)	.11 (375)
WORD	.402	.10 (202)	.11 (375)
DWORD	N/A	.10	.11
Average CGA video write time (μs)[e]			
BYTE	1.208	.94 (128)	1.05 (115)
WORD	2.415	1.86 (130)	2.11 (115)
DWORD	N/A	4.83	4.21
CPU clock rate (MHz)	8.0	20.0 (250)	20.0 (250)
Math coprocessor clock rate (MHz)	5.3	20.0 (377)	20.0 (377)
Refresh overhead (%)	7.1	4.4	10.4
RAM read/write wait states	1/1	0/0	0/0
ROM read wait states	1	Same as RAM read	Same as RAM read
Video write wait states (CGA)	8	16	19
EMM read/write wait states	1/1	0/0	0/0
ATFLOAT			
Performance relative to AT (%)	100	850	720
ATDISK			
Sectors/track	17	63	34
Heads	5	16	5
Cylinders	731	609	1,023
Total disk space (MB)	30.34	299.75	84.91
Track-track seek time (ms)	6.0	6.4	4.9
Average seek time (ms)	37.1	20.7	18.8
Effective transfer rate (KB/sec)	170.1	629.5	509.9
DOS file I/O with/without cache (sec)[f]	7.3	5.0/5.0	3.0/5.8
Interleave	3	1	1

[a] *The figures for the IBM AT and Compaq Deskpro 386/20 are the average results from several machines, whereas the results from the Premium/386 were taken only from the review sample model.*
[b] *Figures shown in parentheses represent the relative performance expressed as a percentage compared with* PC Tech Journal*'s baseline machine, the 8-MHz, 30MB AT.*
[c] *For the Deskpro 386/20, the first number is for memory access with the cache enabled; the second is with the cache disabled. For the Premium/386, first number is for memory access within the same 2KB page; the second is for access not within the same 2KB page.*
[d] *For the Deskpro 386/20 and Premium/386, EMM measurements were taken using extended memory and each system's EMM driver.*
[e] *For the Deskpro 386/20 and Premium/386, video write times were measured using the supplied EGA in CGA mode.*
[f] *Deskpro 386/20 and Premium/386 were tested with/without disk caching program.*

The Premium/386 with its static-column RAM offers computational performance almost equal to that of the Deskpro 386/20, with its Intel 82385-controlled SRAM memory cache. The disk cache provides good performance as measured by ATDISK.

FIGURE 3: ***Performance Comparison***



The AST Premium/386 accesses memory within the same 2KB page as fast as the Compaq Deskpro 386/20 accesses information stored in its high-speed 32KB cache.

provide as their standard, included-with-the-computer documentation. The information is not adequate for such tasks as hardware checkout and maintenance, extensive debugging, or designing/programming for SMARTslot boards and applications. AST is trying to remedy the situation with the publication of the *AST Premium/386 Hardware Maintenance Manual* and the SMARTslot specification.

CLASSIC COMPATIBILITY

To test the compatibility of the Premium/386 with hardware and software designed for AT-type computers, several hardware and software products were chosen to represent typical equipment and to exercise various portions of the computer system.

Although AST's 13MB of memory on its standard proprietary memory board is accessed over a 20-MHz, 32-bit bus, additional memory in the expansion slots is accessed over the 8-MHz, 16-bit bus. Two AT memory boards, the Intel Above Board 286 and the Cheetah Card from Cheetah International Inc., perform without problem.

The bus and serial versions of the Microsoft mouse work well on the Premium/386. Installation of the serial mouse requires a 25-pin-to-9-pin converter because AST uses 25-pin male connectors on both of its serial ports. Although the serial mouse works fine, it uses one of the system's two serial ports. The bus mouse also works without problem, but installation takes longer. Instead of requiring a port, it uses the last available 8-bit slot. While a separate mouse port is standard on machines from IBM, Apple, and Compaq (on its new 386*s*), AST is still among the hold-outs.

For the Premium/386, the first test of software compatibility was the IBM AT Advanced Diagnostics 2.04. The 80387 math coprocessor must be disabled (using ASTSETUP) before the Advanced Diagnostics are run or the system hangs as it tries to identify the math coprocessor (AT Advanced Diagnostics do not recognize the 387). With this accomplished, the evaluation unit passed on diagnostic tests.

Graphics software packages tested worked without problem, although installation of Microsoft Windows/386 requires removing ASTEMM from memory. When the system is booted with ASTEMM installed, Windows/386 will not load because both programs want to be the one and only virtual memory manager. Once installed, however, Windows/386 works well.

The performance of Microsoft Word 4.0 is excellent. The program loads in about 2 seconds, even with a document. Moving the cursor through the text with PgUp and PgDn is virtually instantaneous.

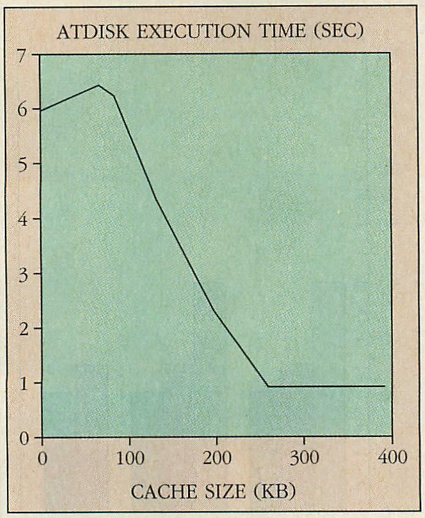
The AST EGA Monitor provides a very crisp display—characters are sharp and colors are clear. However, because the monitor uses relays to switch modes, the screen blanks momentarily, only a minor annoyance in many programs. The image jumps, for example, when switching from graphics to text display in Microsoft Word.

The effect is a little more annoying, however, with PROCOMM, a communications program from Datastorm Technologies that uses "exploding" windows to display pop-up menus for various command options. When a menu pops up, the display mode switches repeatedly from text to graphics and back to simulate the "exploding" window. Each time, the switching relays cut power to the screen. This causes the image to shrink, just as a television picture slowly shrinks when the set is turned off.

Three memory-resident programs, Borland's SideKick 1.56A, Borland's Turbo Lightning 1.01A, and Living Videotext's Ready! 1.00E all perform satisfactorily on the Premium/386. Turbo Lightning, in particular, is extremely quick when the dictionaries are loaded onto RAM disks. Ready! performed without problem using expanded memory created with ASTEMM.

Backing up files using Fifth Generation Systems' Fastback Plus—a good test of DMA capabilities—is extremely brisk, particularly when the Auto Slowdown feature is disabled; the system has no problem with high-speed DMA accesses to the diskette drive while running at 20 MHz. Fastback Plus transfers 72 files totaling 854KB in 23 seconds, yielding a transfer rate of 2,228KB per minute. When the system is run at 8 MHz during diskette accesses, the transfer time increases to 57 seconds, yielding a decreased transfer rate of 899KB per minute.

FIGURE 4: ***ASTCACHE***



As memory cache size is increased to 256KB, the time required to perform ATDISK decreases substantially.

COMMAND PERFORMANCE

The Premium/386 was tested using the *PC Tech Journal* compatibility and performance suite (see table 2 and figure 3). The results of the tests are compared with the results of the tests on an 8-MHz AT and a 20-MHz Compaq Deskpro 386/20. (For an explanation of the tests, see "Out from the Shadow of IBM," Steven Armbrust, Ted Forgeron, and Paul Pierce, August 1986, p. 52, and "Updating the Evaluation Suite," Ted Forgeron, Paul Pierce, and Steven Armbrust, March 1987 p. 70.)

ATBIOS examines the BIOS and the BIOS date areas. In the test of the Premium/386, the AST copyright date is 12/16/87. The Premium/386 BIOS is from Award Software, whereas the Premium/286's BIOS was developed by Phoenix Technologies.

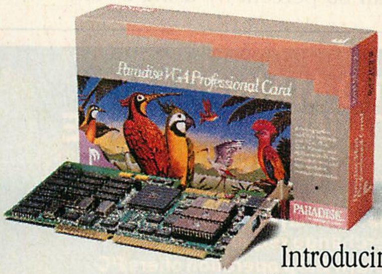
ATKEY tests AT keyboard compatibility. The review unit passed the test.

ATPERF measures memory access times and CPU and math coprocessor clock rates. In general, the Premium/386, with its static-column RAM, has performance equal to the 20-MHz IBM PS/2 Model 80, but is slightly slower than the Deskpro 386/20.

ATFLOAT measures the time taken to perform 100 multiplies on a 20-by-20 matrix and then compares the time to that required by an 8-MHz AT equipped with a 287. Here again, the Premium/386 is slower than the Deskpro with its 32KB SRAM memory cache, but equal to the Model 80. The Premium/386 measures 7.2 times faster than a standard AT.

ATDISK evaluates hard-disk performance. The AST 90MB drive is very fast, clocking in with access times just over 18 ms. The ESDI controller also provides for an extremely fast overall data-transfer rate.

Open your windows faster.



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CIRCLE NO. 235 ON READER SERVICE CARD

Use of ASTCACHE can substantially increase the performance as measured in ATDISK. The performance increase, however, is extremely dependent on the amount of memory allocated for the cache. AST's instructions on sizing the memory allocated for disk caching are simple: make the cache as big as possible. ASTCACHE can accommodate a cache as large as 1MB.

ATDISK includes a test that writes and then reads ten 20KB files. The time to complete this test can reduced by more than 80 percent by using a sufficiently large cache. If the cache is too small, however, performance is degraded (see figure 4). By increasing the size of the cache, the time required is gradually reduced. For this particular test, caches larger than 256KB provide no additional improvement.

WELL INTEGRATED

The AST Premium/386 is a solid unit that demonstrates sound design and quality manufacturing. The unit is a well-integrated combination of hardware and software that produces excellent performance ratings. The operation of the Premium/386, while not the fastest in any one category, is near the top when the total integrated performance is considered.

AST designed the Premium/386 to compete against IBM's PS/2 Model 80 and Compaq's Deskpro 386/20. It offers performance that is equal to that of the Model 80, but not quite as good as the 386/20. The 386/20's performance edge stems mainly from its Intel 82385-controlled 32KB SRAM memory cache. However, by judicious use of the AST performance-enhancement utilities, notably ASTCACHE and FASTEGA, the Premium/386 achieves some very good performance numbers.

The Premium/386 retains full compatibility with DOS/AT standards, while providing a novel means of expanding that capability. However, two questions remain concerning SMARTslot, not the least of which is, will there ever be a SMARTslot expansion board? IBM's Micro Channel Architecture has been out since April 1987, but no flood of expansion cards that require multimaster bus control has followed—few cards currently use this capability.

Second, will anyone besides AST ever make a SMARTslot computer or a SMARTslot expansion board? IBM is finally starting to make noises about licensing Micro Channel Architecture. Both Intel and Chips and Technologies are providing chip sets for controlling and using the Micro Channel bus. Nobody is making a SMARTslot chip set. Unless other manufacturers quickly adopt the SMARTslot standard in their computers, the market for SMARTslot expansion boards will never exist.

Unless the answer to both questions becomes an emphatic "yes," the SMARTslot concept will never reach the critical mass of users to become a real standard. Regardless of the answers, however, the AST Premium/386 is a very capable performer that maintains AT-bus compatibility.

First with the introduction of the Premium/286 and now with the Premium/386, AST is making the transition from board manufacturer to full-fledged computer manufacturer.

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714/863-1333
Premium/386

CIRCLE 338 ON READER SERVICE CARD

David Claiborne is a technical manager for JAYCOR in Edgewood, Maryland.

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FRONTRUNNER *(a new Ashton Tate product created by Apex Software)*

FrontRunner generates memory-resident **pop-up** applications using the dBASE III Plus or dBASE IV programming language. Once your memory-resident program is created, **pop-up** your program while using Lotus 1-2-3, any dBASE program, Clipper, Basic, any word processor, DOS or any program written in any language. Pop-In and Pop-Out of any software package instantly. All data files and indexes created are dBASE compatible. FrontRunner applications can be compiled into binary files for protected distribution and unparalleled speed. The user selects a hot-key to call up an application. Use the unique POWERKEY feature to define additional hot-keys within the application. A powerful paste command allows the user to extract data from a FrontRunner application into a word processor, spreadsheet or other application. Use FrontRunner for **pop-up** help screens, account listings, phone directories, schedules, random notes, printing mailing labels.... anything imaginable.

FrontRunner....List: **$295**, Ours: **$195** *(new low price!)*

GREENLEAF LIBRARIES

Functions

C source, assembler source, and binary libraries of 225 functions for many compilers. Emphasizes tight functional groupings to minimize loading code which your application may never use. Manual's 250 pages help select functions, as do demos, bulletin board.

Communications

Communicate from within your own C programs! Over 120 functions and demo programs in C and assembler source to set up interrupt-driven asynch communications for up to 16 channels. Up to 9600 baud, ASCII or binary, any parity or word length, 8250 UARTs, Xon/Xoff and Xmodem, WideTrack receive. Goodbye separate communications software. Specify compiler.

Data Windows

Windows, menus and data entry do work together...when you utilize Greenleaf's screen architect. This smooth screen designer offers device independence, logical windows, table driven data entry and economical pricing. Source code is also available.

	List	Ours
Communications	**$185**	**$139**
Functions	**$185**	**$139**
Data Windows	**$295**	**$249**
Complete 3 in 1 Pack	**$665**	**$475**

Shopping List for the Power Workbench

	LIST	US
ASSEMBLER		
Microsoft Macro Assembler with Utilities	150	109
PASM 86 *by Phoenix, Macro Assembler*	195	109
ASSEMBLER Support		
Btrieve Softcraft's File Manager	245	175
GSS CGI....*Device independent graphics*	495	425
BASIC		
Microsoft BASIC Interpreter..*for XENIX*	350	249
Microsoft QuickBASIC...*Ver 4.0*	99	66
Turbo BASIC.......*NEW from Borland*	100	75
BASIC LIBRARIES & UTILITIES		
Btrieve Softcraft's File Manager	245	175
GSS CGI....*Device Independent Library*	495	425
Halo Graphics by Media Cybernetics	325	249
C LANGUAGE COMPILERS		
C86 PLUS by Computer Innovations	497	397
Lattice C Compiler Now ver 3.2	450	299
Let's C Compiler from Mark Williams Co	75	55
Mark Williams C full development system	495	369
Microsoft C Compiler with free CODEVIEW	450	295
Microsoft QuickC....*Special Price*	99	66
Turbo C.......*New from Borland*	100	75
C LIBRARIES—Communications		
Asynch Manager by Blaise	175	135
Greenleaf Communications	185	139
Essential Communications	185	125
Essential Communications Plus	250	189
C LIBRARIES—FILE MANAGEMENT		
Btrieve Softcraft's File Manager	245	175
Btrieve/N File Management for Networks	595	445
Ctree by Faircom,with full source	395	299
Rtree...*Report Gen. for Ctree*	295	235
Ctree & Rtree.....*Special Combination*	650	499
dBC ISAM Accesses dBase files	250	175
with Source code	500	349
dBC III Plus multiuser	750	595
with Source code	1500	1195
Opt Tech Sort Super fast sort for Btrieve	149	105
XQL....SQL *from NOVELL*	795	595
C LIBRARIES—Graphics		
Essential Graphics...*no royalties*	299	225
GSS CGI....*Device independent graphics*	495	425
GSS Metafile Interpreter stores images	295	265
Halo '88 by Media Cybernetics	325	249
Halo for Microsoft Languages	595	434
C LIBRARIES—Screen Design		
Curses from Lattice,UNIX lookalike	125	99
with source	250	199
C Worthy....*by Custom Design Systems*	195	159
C Worthy with Forms	295	269
Greenleaf Data Windows	295	225
Microsoft Windows Dev. Toolkit	500	365
Panel Plus by Roundhill	495	395
View Manager for C,Blaise	275	199
Vitamin C...*Creative Programming*	225	198
VC Screen...*Source code Generator*	100	81
Windows for C	195	149
Windows for Data	295	259
Zview....*Data Management Consultants*	245	175
C UTILITY LIBRARIES		
Basic C....*Basic-like routines for C*	175	139
Blaise C Tools Plus/5.0....*f/MsC & QuickC*	129	99
Blaise Turbo C Tools...*f/TurboC*	129	99

	LIST	US
C Food Smorgasbord by Lattice	150	109
C Utility Library by Essential,300 functions	185	119
Greenleaf Functions	185	139
PforCe by Phoenix, vast library	395	199
OTHER TOOLS		
BASTOC...*JMI,Translates BASIC to C*	495	399
dBX Translator......*dBASE to C translator*	550	419
with Library Source	950	725
Pre/C....*by Phoenix, like UNIX lint*	295	154
PC-LINT..*by Gimpel, subset of UNIX Lint*	139	125
COBOL		
Micro Focus COBOL/2	900	795
Micro Focus Toolset	900	795
Micro Focus Personal COBOL	149	134
Microsoft COBOL inc. COBOL Tools	700	499
for XENIX	995	749
RM/COBOL...*by Ryan McFarland*	950	675
RM/COBOL 85...*ANSI 85*	1250	895
COBOL Support		
Btrieve Softcraft's File Manager	245	175
GSS CGI....*Device independent graphics*	495	425
Halo.......*from Media Cybernetics*	325	249
RM/Screens..*Screen generator*	395	335
RM/Net+ 5...*R/M COBOL networking*	300	249
DBASE & RELATED PRODUCTS		
Applications Plus....*Fox & Geller*	299	249
Brief & dBrief..*Editor/Macro lang for DBase*	275	219
Clipper.....*Nantucket's DBase Compiler*	695	399
DATA-p..........*Wallsoft*	60	50
dBC III Plus supports multiuser commands	750	595
with Source code	1500	1195
dBC ISAM...*accesses dBase files*	250	175
with Source code	500	349
dBX Translator......*dBASE to C translator*	550	419
with Library Source	950	725
dFlow.......*Wallsoft*	149	124
Documenter.......*Wallsoft*	295	244
FoxBase+.....*Fox Software*	395	219
Multiuser version	595	349
QuickCode Plus........*Fox & Geller*	295	170
QuickEntry............*Fox & Geller*	99	59
QuickReport...........*Fox & Geller*	295	170
UI Programmer....*Wallsoft*	295	244
FORTRAN Compilers & Utilities		
Btrieve: Softcraft's File Manager	245	175
GSS Graphics Development Toolkit....*CGI*	495	425
GSS GKS...*Kernel Sys,ANSI Level 2b*	495	425
Halo '88.......*from Media Cybernetics*	325	249
Microsoft Fortran..*Ver 4.0,inc. Codeview*	450	295
for XENIX	695	499
R/M Fortran...*ANSI 77 by Ryan McFarland*	595	425
for XENIX	750	599
Spindrift Library....*By Spindrift Labs*	149	129
PROLOG		
APT..*PROLOG Tutor*	65	59
Arity PROLOG Compiler & Interpreter	650	569
Arity PROLOG Interpreter	295	229
Arity Standard PROLOG	95	77
PROLOG-86 Plus.........*Solution Systems*	250	199
Turbo PROLOG...*Borland Intl.*	100	75
Turbo PROLOG Toolbox...*Borland*	100	75
TEXT EDITORS		
Brief......*from Solution Systems*	195	155
dBrief..*Macro lang for Brief & DBase*	95	75

	LIST	US
Brief & dBrief Combo	275	219
Condor Editor....*Condor Corp SUPER SALE*	130	65
Epsilon.....*Lugaru*	195	149
KEDIT.....*Mansfield..identical to XEDIT*	125	99
KEDIT Ver. 4.0	150	119
Pmate.....*Phoenix*	195	109
Vedit Plus.........*Compuview*	185	129
DEBUGGERS		
Advanced Trace 86.....*Morgan*	175	119
C-Sprite...*Source debugger for Lattice C*	175	139
Periscope I...*Board, Switch, Software*	345	289
Periscope II..*Breakout Switch & Software*	175	139
Periscope II.....*Software only*	145	105
Periscope III....*8 Mhz*	1095	875
Periscope III...*10 Mhz*	1195	975
Pfix 86 Plus....*Phoenix symbolic debugger*	395	199
LOGITECH		
MODULA-2 Compiler Package	99	79
MODULA-2 Development Pkg	249	199
MODULA-2 Toolkit	169	139
MODULA-2 ROM Package	299	239
MODULA-2 Window Package	49	39
PHOENIX		
Pasm 86......*Macro ASSEMBLER*	195	109
Pdisk......*Disk Management Utility*	145	95
PFantasy....*six-pack take-away*	995	569
PFinish......*Profiler*	395	199
PFix 86 Plus.Symbolic Debugger	395	199
PForCe.......*Utility library*	395	199
PforCe...*Pforce for C*	395	199
PLink 86+...*sophisticated overlay linker*	495	269
PMaker.........*make utility*	125	74
Pmate........*Text Editor*	195	109
Pre-C.........*Super-set of UNIX Lint*	295	154
Ptel.........*Binary Transfer Program*	49	39
POLYTRON		
PolyBoost....*Software accelerator*	80	64
PolyDesk III..*3rd Generation Desktop org*	99	73
PolyLibrarian...*Library Manager*	99	89
PolyLibrarian II	149	129
PolyMake......*Complete MAKE Utility*	149	129
PolyShell.....*UNIX-like Command Shell*	149	109
PolyXREF2...*Cross Reference Util all lang*	219	169
PolyXREF2...*Single Language support*	129	99
PVCS Corporate...*Source Code Control*	395	329
PVCS Personal...*Personalised ver of above*	149	129
PVCS Network...*Powerful Ver. of PVCS*	Call	Call
RYAN McFARLAND		
RM/COBOL......*ANSI 74 Standard*	950	675
for UNIX or XENIX	1250	999
RM/COBOL 85.....*ANSI 85 Standard*	1250	895
RM/FORTRAN.....*ANSI 77 Standard*	595	425
for UNIX or XENIX	750	599
RM/NET+ 5....*COBOL Networking*	300	249
RM/Screens.....*COBOL 85 Screen generator*	395	335
SOFTCRAFT		
Btrieve Softcraft's File Manager	245	175
Xtrieve...*Query language for Btrieve*	245	220
Report Option for Xtrieve	145	128
Btrieve/N File Management for Networks	595	445
Xtrieve/N.....*Multi-User Query*	595	459
Report Option/N...*Multi-user Rep Opt*	345	269
XQL......*SQL for Btrieve*	795	595

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PROGRAMMING PRODUCTIVITY TOOLS

ESSENTIAL C UTILITY LIBRARY

400 Functions, 30¢ Each

You've probably seen the speed and power of Essential's C function library without knowing it. Software greats have been using it for some time to give today's top products pizazz and panache.

Now grown to 400 functions Essential produces pop-up menus, save and restore screens and windows to disk or memory in as little as 1/10th second, and the fastest video output available. Library has a complete set of 50 business graphics functions, 40 string handlers, 28 functions for printers, 18 for mice, 11 for time and date. DOS interfacing functions offer disk error trapping, directory and file management. Everything in source, including sample programs that demo library functions. We have versions with pre-built libraries for all well-known C compilers, and a source code librarian is supplied for rolling your own.

	List:	PC Express
C Utility Library	**$185**	**$119**
Essential Graphics	**$299**	**$225**
Essential Communications	**$185**	**$125**
with Breakout Debugger	**$250**	**$189**

C-TREE & R-TREE

B-Tree File Manager Now Has Report Generator

c-tree: The only major b-tree file manager with network support in the standard low-cost version. c-tree™ gives you record-locking routines for DOS 3.1/3.2, UNIX and XENIX, and it even comes in C source code, yet there are no royalties. Source sticks to K&R, so c-tree is portable. Tests in many environments prove it.

Permits any number of keys for a data file—alpha, numeric, even floating point. Handles files with varied record lengths, multiple keys in one index file. Both high level and decomposed functions. It's the works.

r-tree: Adds the ability to produce ad hoc reports from files maintained by c-tree (v. 4.1 and up). Link a file description to the r-tree™ library, and use any text editor to write report scripts with no further C coding. Reports can access data in several files, select on criteria, join findings into new logical records, sort them, calculate new fields and columns, tabulate by control breaks. Comes in source, same portability as c-tree, and fits any compiler.

	List:	Ours:	Combined:
c-tree:	**$395**	**$299**	**$499**
r-tree:	**$295**	**$235**	

WINDOWS for DATA

M'soft Windows Compatible

"Onlt one package can be easily recommended" said *Computer Language* (June '87) reviewing nine window and data entry products for C. Complete field level functions specify prompt string, field length, data type, screen location, picture, target variable, entry rules, help messages, even functions to call for validation once data keyed in.

Windows for C is a subset. No data entry but all windowing functions. Unlimited windows can be made either to pop up or permanently overwrite the screen, scroll and highlight lists vertically and horizontally. Specify Compiler. Windows for Data: List **$295**, Ours **$259**. Windows for C: List **$195**, Ours **$149**.

BLAISE C TOOLS PLUS/5.0

C TOOLS PLUS/5.0 from Blaise Computing Inc. helps you to quickly build professional applications using the full power of Microsoft C 5.0 and QuickC. Now you can concentrate on program creativity by having full control over DOS, menus, interrupt service routines, memory resident programs, fast direct video access; windows; printer and keyboard control, and more!

Blaise Computing's attention to detail, like the use of full function prototyping, cleanly organized header files, and a comprehensive, fully-indexed manual, makes C TOOLS PLUS/5.0 the choice for experienced developers as well as newcomers to C.

C TOOLS PLUS/5.0 prebuilt libraries are ready to use with either QuickC or the Microsoft C 5.0 command line environment. Complete documented source code is included so you can study and adapt it to your specific needs.

	List:	PC Express:
C TOOLS PLUS/5.0	**$129**	**$ 99**
Turbo C TOOLS	**$129**	**$ 99**
C ASYNCH MANAGER	**$175**	**$135**
Turbo POWER TOOLS	**$ 99**	**$ 75**
Turbo ASYNCH PLUS	**$ 99**	**$ 75**

PANEL PLUS

Library Source Code Gives It Complete Portability

There are no end of tools for screen design and data entry, but none quite like Panel Plus. Design a screen under program control, use Panel's utility to "run" and test it field by field, then pass it to Panel's code generator which delivers C source code. Options style the code to your compiler's liking, and you can of course do what you like to the source afterward. The code calls Panel Plus's function library, but now *the library comes in source*, so everything produced is highly portable. Not like other screen managers delivered as object libraries and which leave *you* to write the detailed code.

Panel Plus will operate in graphics mode via interfaces to graphics products it supports and can utilize the EGA's 43-line screen. Low-level I/O functions adapt it to various keyboards, screens, operating systems.

Panel's newest incarnation has every imaginable feature. A single screen design can have 1000 fields stacked as visual overlays up to 127 levels deep or as pop-ups. Groups of fields can be moved between levels. Screens can be output as compilable code or stored on disk for loading at run-time. Each field can be boxed, colored, multi-row, word-wrapped, and scrolled horizontally and vertically if larger than its on-screen view aperture. It can be assigned its own help and error message, can be told to accept certain characters, or to match a picture, and to check data after entry—proper dates, number ranges, etc.—using Panel's or your own validation routines. You can add your routines to Panel's test utility because even it comes as source. Fields are accessed in any order and control reverts to your application program after each field for choice of action.

For past Panelists, the new version has smaller and faster field and screen functions, tighter granularity, and an enhanced, reworked library. Major tool for the serious developer. List: **$495**, PC Express: **$395**.

POLYTRON VERSION CONTROL

Source Code Control for Any Language

PVCS allows programmers, project managers, librarians and system administrators to control the proliferation of revisions and versions of source code in software systems. Independent programmers, the leading software publishers and LAN companies, and hundreds of Fortune 1000 companies rely on PVCS to store and retrieve multiple revisions of text. It maintains a complete history of revisions as an "audit trail", generates status reports, and uses intelligent "difference detection" to minimize disk space for each new version.

On Corporate and Network PVCS simultaneous changes to a module are merged into a single new version. If changes conflict, the user is notified.

The "Logfiles" used to track changes are interchangeable between any PVCS product.

Corporate PVCS is for multiple programmers. It includes "branching" to maintain code when programs evolve on multiple paths. Personal PVCS offers most of the power and flexibility of corporate PVCS, but excludes multiple programmer features. Network PVCS is the Corporate version for LANs. File locking and security levels can be tailored to each project.

Ask for:	List	PC Brand:
Personal PVCS	**$149**	**$129**
Corporate PVCS	**$395**	**$329**
Network PVCS	**Call**	**Call**
PolyMake	**$149**	**$129**

dBC *Identical dBASE III Plus Files Using C*

dBC™ is a series of C libraries from Lattice which creates, accesses and updates files identical to those of dBASE itself. So dBASE can read and update the files too.

What for? It means both C and dBASE applications can operate on the same data bases interchangably. It means C programmers can interface with the big market of dBASE users out there, yet side-step the dBASE language. It means dBASE applications can now be linked to the universe of C libraries and tools to add windows, graphics, statistical analysis, all the things dBASE cannot do. It means the speed and power of C to impress clients accustomed to dBASE!

dBC's functions parallel all dBASE's file handling commands, many decomposed to permit direct data manipulation. Our versions of dBC mimic file formats for dBASE II and III and now dBASE III Plus makes your programs network ready!... as many stations as a network allows. Hands-off mode handles record and file locking and unlocking automatically. Close in functions give you direct lock/unlock control.

Supports all four memory models.
dBASE II, III...List: **$250**, Ours: **$175**.
dBASE III Plus...List: **$750**, Ours: **$595**.
Call for Source Code Pricing.

C-WORTHY INTERFACE LIBRARY

The C-Worthy™ Interface Library wraps an entire user interface around your application. Its full power can be summoned by only a few high level calls. Sound exaggerated? A single function call can set up a complete text editor in a screen window. Recently acquired by Solution System, over 600 pages of Documentation, Turbo and Quick C version and a complete Interface Library have been added.

- High level calls pop menus and scrollable choice lists to the screen, restoring the background when dismissed.
- Windowing facilities open portholes of up to screen size for viewing virtual screens larger than the physical screen.
- Full context-sensitive help screen management takes over these chores and error messages. Automatic routines interrupt with pageable text windows explaining what to do next.

Novell found it "played a key role and accelerated development" in making its NetWare™ utilities easier for users. Ingenious demo: call for it.

Ask for:	List:	PC Express:
C-Worthy	**$195**	**$159**
with Forms Library	**$295**	**$269**

THE SPINDRIFT LIBRARY

Fully Functional Fortran Library.

Spindrift's smooth package offers something previously unavailable to the Fortran buffs...a basket of functions, packed to the brim. No more tedious coding. Just call on Spindrift with it's armoury of functions.

Any number of Windows may be defined, each with a striking border and brilliant color. Define "pop-up" screens, Save/Restore images, set Cursor shape. Snare an entire screen into a Character array.

The Keyboard; read it without echo, or sense any keypress during execution. Cursor controlled directly with Edit keys.

DOS interface includes: Call System, Call Exec, Findfrst/Findnext for (*) and (?) file searching. Search the Path, subdirectory and file manipulation, command line argument parsing, date/time functions, DOS environment access, and much more. Other utilities also included.

Specify compiler, Microsoft or Ryan McFarland. List: **$149.00**. Us: **$129.00**

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Shipping & Handling: U.S.: UPS Surface: 1st product $6, each add'l $3. UPS 2nd Day Air: 1st product $12, each add'l $6. UPS Next Day Air and Federal Express shipment costs based on weight. International: Charges vary by destination and carrier. $10 per shipping container for export forms. Air parcel post at your risk beyond collected insurable amount.

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PC EXPRESS™ PROGRAMMER'S WORKBENCH

dBASE AT THE SPEED OF C

dBx Translates dBASE Applications to C

You dBASE™ programmers know what an expressive and readable language dBASE is. It's a very comfortable development environment. But the price is debased performance. Even compiled dBASE doesn't offer the speed that some users require these days. The kind of speed offered by software written in the C language. The answer is dBx™

dBx translates dBASE to C. It offers you a major competitive advantage over the next dBASE programmer: Keep writing in dBASE. Take every application all the way to completion. Then use dBx to translate them top to bottom to C!

Other advantages: C is portable, even to other operating systems like UNIX/Xenix™. To the Macintosh or Amiga. dBx gives your applications a passport to places dBASE cannot go.

Has its own file manager for single user, but links to major C file managers—c-tree and dBC—for compatibility with dBASE files or multi-user support. We have everything you'll need, including good advice.

	List:	Ours:
dBx	**$550**	**$419**
with Library Source	**$950**	**$725**
Call for Full Source Pricing		

BRIEF/dBRIEF

The Power Environment for dBASE Programming

Many worthy utility products supply needs that dBASE®'s programming language doesn't—dUTIL™, dFLOW™ and a host of others. Trouble is, you have to use them separately, then combine their output into your dBASE program files.

No longer. dBRIEF™, written in BRIEF's macro language, grabs hold of BRIEF and turns it into a complete dBASE III and III Plus programming domain. Using BRIEF's underlying shell capabilities and its own interfaces, dBRIEF can run external utility libraries, plus dBASE itself, and link to the Clipper™, Foxbase+™ and Quicksilver compilers, all with dBRIEF still loaded and running the show. It can do what BRIEF already does plus:

- Convert a screen layout into dBASE code for interactive data entry.
- Display dBASE file structures in windows, a great convenience alongside your program files.
- Expand keystrokes into full dBASE statements.
- Indent automatically for clegic display.
- Create databases; index files; invoke Ashton-Tate's dFORMAT™ and dCONVERT™; draw lines and boxes.

"Simply marvelous programming environment for writing and editing dBASE programs.", *PC Magazine*, 7/86. Source code included!

Requires BRIEF 1.32 or later and 384k; 512k to run dBASE within dBRIEF; 640k and harddisk recommended.

BRIEF/dBRIEF...List **$275**,Ours: **$219**.

APPLICATIONS PLUS For dBASE

The Complete dBASE Companion

Who says you can't have it all?

APPLICATIONS PLUS has *everything* you need to get the most out of dBASE: An application generator (QUICKCODE PLUS), relational report writer (QUICKREPORT), and graphics system (dGRAPH).

QUICKCODE PLUS offers *dozens* of features you've *never* seen before in a dBASE code generator. Relational applications that read, display, and update a dozen or more databases simultaneously. "Real-time" calculations, performed *on screen* as the user enters each field. Forms up to 11 screens long, with the ability to pass data between screens. Computational formulas that automatically combine data from *different* databases. 9 Data types. 16 field types.

QUICKREPORT is a full-featured relational report writer, which combines up to 6 databases in one report, handles many-to-one relations, fancy printer features (like **bold** and *italics*), computed fields, and up to 16 levels of totalling and sorting.

dGRAPH is a graphics system that produces bar, pie, line, and piebar charts directly from dBASE data. Dozens of options let you tailor graphs to your needs.

APPLICATIONS PLUS is 100% compatible with Clipper and FoxBASE+.

	List:	Ours:
APPLICATIONS PLUS	**$299**	**$249**
QUICKCODE PLUS	**$295**	**$170**
QUICKREPORT	**$295**	**$170**
QUICKENTRY	**$ 99**	**$ 59**

MICROSOFT LANGUAGES

Powerful Implementations Of The Most Popular Programming Languages

Microsoft C 5.0: The flagship of the Microsoft line runs up to 30 percent faster than its predecessor. Its new optimization features deliver untouchable execution speeds, 100 new additional library routines...

Microsoft MacroASSEMBLER 5.0: If you ever wanted to take on the challenge of assembly, here's your opportunity. "MASM" 5.0 is a lot easier to use, has completely revised documentation, and a new "Mixed Language" programming guide that gives you step by step instructions for linking your assembly code with other Microsoft languages.

Microsoft QuickBASIC 4.0: is a revolutionary concept in BASIC programming. It allows you to run, edit, debug, and run again. Our friends at Microsoft have eliminated the dreaded compile step. Whenever you edit your code QB4 automatically incorporates your changes, so that it can run a program of 150,000 lines in less than a minute.

Each member of this language family includes the renowned debugger CODEVIEW.

	List:	Ours:
Microsoft C	**$450**	**$295**
Microsoft Macro-ASSEMBLER	**$150**	**$109**
Microsoft QuickBASIC	**$ 99**	**$ 66**
Microsoft FORTRAN	**$450**	**$295**

NOVELL: BTRIEVE, XQL, XTRIEVE

Sophisticated Tools Essential For Fast Database Handling

Btrieve is a library of subroutines that allows the programmer to build a database application using any language. It takes complete charge of all file creation, indexing, reading, writing, insertion, deletion, forward and backward searching. Its balanced tree indexing scheme finds any key in a million in less than 4 accesses...That's fast!

Btrieve is multi-lingual also. It includes more than 20 language interfaces (including C, BASIC, PASCAL, FORTRAN). However if it turns out that you are using something a little unusual, worry not. The manual includes a chapter on how to write a language interface to Btrieve.

Btrieve's vital statistics are equally impressive. Files may have up to 24 indexes; fixed record length to 4090 characters; variable length to 64K; indexes to 255 characters; files of 4 billion bytes. Network support includes Novell, 3-COM, IBM PC NET, Software Link's Multilink and many others.

XQL is a relational database management system designed especially for programmers. Imagine being able to access your database with the ease of SQL (Structured Query Language) statements and still having the power to process that data right down to the byte level.

Think about your applications. A large part of your software development effort is probably devoted to managing data stored in files on disk. Hours spent writing lines of code to search and store data records could have been used to program more important parts of your application. Why not let XQL do it for you. XQL will increase your programming productivity and let you focus on building better applications.

The XQL system works in tandem with Btrieve and has an equally powerful chassis...No limit on the number of records per file. Max. file size is 4 gigabytes, Max. record size equals 4K, Max. indexes per file is 24. The one version works for single or multiuser systems, DOS Ver 3.0 or greater. All languages are supported.

Xtrieve is the final ingredient in the Novell programming recipe. It is a menu driven, data retrieval system, that allows you to quickly find information and display reports. System developers can easily customize Xtrieve to display command menus, help files, and error messages in the English spoken by the customer. Xtrieve screens then gives menu choices that users can quickly recognize, making Xtrieve an easy product to use and understand.

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Btrieve/N	**$595**	**$445**
XQL	**$795**	**$595**
Xtrieve	**$245**	**$220**
Xtrieve/N	**$595**	**$459**
Report Option	**$145**	**$128**
Report Option/N	**$345**	**$269**

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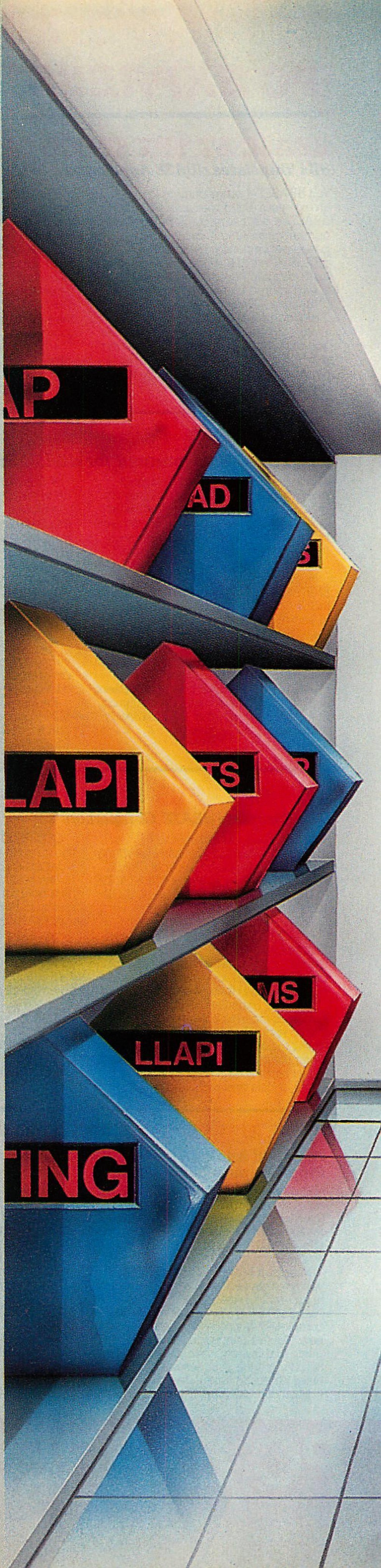
Developing for NetWare

With its rich set of NetWare APIs, Novell leads the charge toward the development of applications for networks. The only fumble may be that its APIs are proprietary.

RALPH DAVIS



The next round of LAN wars likely will be won by the vendor whose application programming interfaces (APIs) are accepted as the future standard for network application development. Novell has won the initial LAN battles with its advanced file-server software, but sophisticated LAN applications of the future will require more than dependable file service and support for DOS calls.

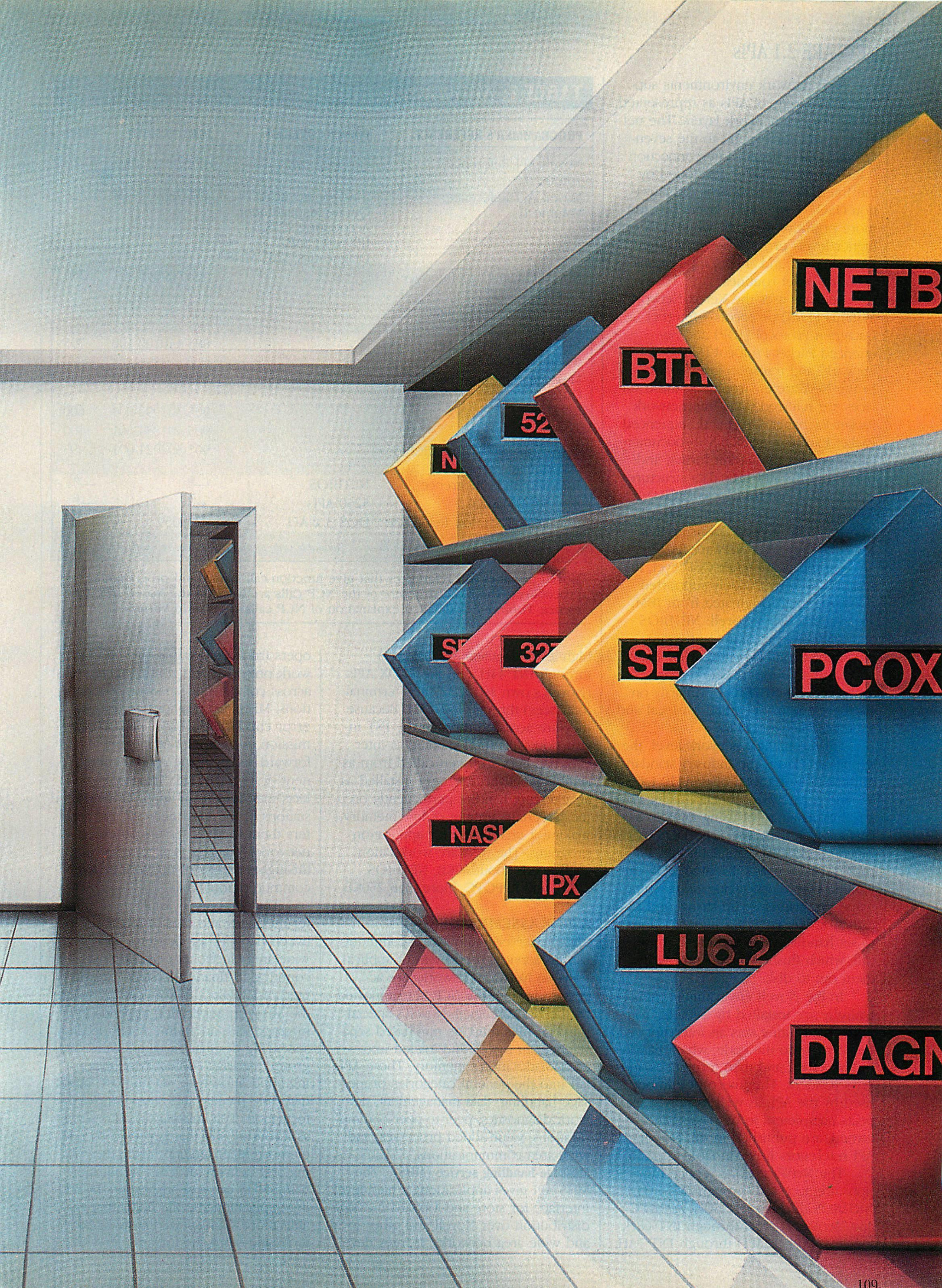
Anticipating the need for robust LAN application services, Novell has put a lot of effort into developing and promoting its network APIs. As a result, the company has a good head start in the API battle. More than 2,500 registered software developers participate in Novell's NetWare API program, which has produced useful network applications of all types.

Programs written to the Novell APIs provide some of the most advanced network services available. To gain this power, however, users must sacrifice portability, because Novell APIs are proprietary and run only on networks with file servers that use Novell's NetWare software. (Novell still provides a wide audience, with an installed base of servers and workstations of well over 1 million nodes.)

Network applications written only to DOS, on the other hand, will run on virtually any PC LAN, including Novell's NetWare, Banyan's VINES, 3Com's 3+, and Microsoft network derivatives such as Hewlett-Packard's OfficeShare and Torus's Tapestry. This is an important advantage for general-purpose commercial software. The DOS repertoire of functions for network access and control is so limited, however, that justifying their exclusive use may be difficult in any application requiring advanced network functionality. NetWare offers the powerful environment required for developing more advanced network applications. (For a review of NetWare 2.1, see "Novell Advances," Steven S. King, June 1988, p. 58.)

NetWare's basic client API, known as the NetWare Core Protocol (NCP), provides more than 200 functions; all are accessed with standard INT 21H calls. The NCP encompasses the file, print, communications, and administrative services accessible to any PC on a NetWare LAN. Supplementary APIs from Novell require additional software and support terminal emulation, peer-to-peer communications, data-management routines, and other specialized network functions.

ILLUSTRATION • PAUL NEWMAN


NETB
BTR
52
SEC
PCOX
IPX
LU6.2
DIAGN

Most network environments support a hierarchy of APIs as represented by the various network layers. The network layers correspond to the seven-layered Open System Interconnection (OSI) protocol model developed by the International Standards Organization (ISO). Lower-level layers provide more primitive services, while APIs on higher levels provide powerful high-level services and shield applications from low-level routines.

NetWare uses the Xerox Network Systems (XNS) protocols—Internet Datagram Protocol (IDP) and Sequenced Packet Protocol (SPP)—for its network- and transport-layer services. In the NetWare environment, these services are referred to as Internetwork Packet Exchange (IPX) and Sequenced Packet Exchange (SPX). XNS documentation defines the packet format and usage, but the API uses data structures called event control blocks (ECBs), which are Novell's implementation. Consequently, a program using this API runs only on a NetWare LAN.

On the next-higher OSI level, the session level, two widely supported standards, both originated from IBM, are available from Novell: NETBIOS and advanced program-to-program communications logical unit 6.2 (APPC LU 6.2) Both support peer-to-peer communications—NETBIOS primarily on local area networks, APPC on local and wide area networks.

On the highest network level, the application layer, the industry-standard API consists of a total of only 10 DOS 3.1 and 3.3 network function calls. (For a full explanation of using DOS in a LAN environment, see "The DOS-LAN Juncture," J. Scott Haugdahl, July 1987, p. 78.) The network-oriented DOS calls include byte range locks, get machine name, set printer setup string, and redirect device. DOS 3.3 adds functions to set handle count and the commit call, which flushes buffers and writes them out to disk.

In the Novell environment, APIs typically are installed by a loader routine. This routine sets an interrupt vector to point to the code, which handles the interrupt, and then terminates and stays resident. The interrupt number used by the API, as well as how it expects parameters to be passed and returned, are published in the Novell API references listed in table 1.

TABLE 1: ***Novell API References***

PROGRAMMER'S REFERENCE	TOPICS COVERED	PART NUMBER	PRICE
Novell API Reference, Volume I	Function calls	452-760041-001	$ 25
Novell API Reference, Volume II	Bindery, Security, Queue Management, Accounting, TTS, IPX/SPX, SAP, Diagnostics, VAP, MHS	452-760042-001	25
Novell C Language Interface Reference		452-760043-001	250
Btrieve Record Manager Reference		—[a]	—[a]
XQL Interface with API documentation		883-440100-100	795
Message Handling Interface Guide		883-000590-001	145
NetWare LU6.2 Tools		905-301992-001	600
PCOX/3270 Tools		905-301834-001	100
Asynchronous Communication Server with API		905-302021-001	1,495
IBM NETBIOS Reference	NETBIOS	—[b]	—[b]
IBM 5251 Manual	5250 APIs	—[b]	—[b]
IBM DOS Technical Reference	DOS 3.*x* API	6280059	85

[a] *API included with NetWare 2.1 and later.* [b] *Available only through IBM sales representatives.*

Novell provides API references that give function-call syntax and programming procedures. The basic structure of the NCP calls are listed in the *Novell API Reference, Volume I.* A detailed explanation of NCP calls is given in *Volume II.*

The NetWare Core Service functions are accessed through INT 21H, NETBIOS through INT 5CH, APPC/PC and NetWare LU 6.2 through INT 68H, low-level API (LLAPI) through INT 7AH, high-level language API (HLLAPI) through INT 44H, and the PCOX APIs (Novell's own set of 3270-PC terminal interfaces) through INT 6FH. Because they are accessed through the INT instruction, APIs implemented as interrupt handlers are often called from assembly language. Each API installed as an interrupt handler permanently occupies a certain amount of low memory, making it unavailable for application programs. The NetWare workstation shell needs about 60KB; NETBIOS, 20KB; and APPC/PC, more than 250KB.

A FINE ASSEMBLAGE

The file-server and network-communications services used by most applications on NetWare networks are accessed through the NCP API supported by the NetWare shell. Novell's special-purpose APIs must be purchased separately from Novell and loaded into each workstation's memory. These APIs fall into the general categories of message handling, data management, network diagnostics, peer-to-peer communications, value-added processes, and wide-area communications.

Message-handling service (MHS). The MHS API gives applications a high-level interface for store-and-forward message distribution over Novell and other local and wide area networks. It frees developers from worrying about the network protocols and routing techniques across complex internetwork connections. MHS also provides security and error checking during message transmission. A dedicated MHS store-and-forward server is the central component of the MHS API. This server collects messages from applications on the stations of the local network and transfers them to MHS servers on other networks. Transfer is accomplished through a variety of network or telecommunications links.

The MHS API is available to transfer messages and files of any type between network applications, such as wide-area electronic mail, large accounting or financial systems, distributed order entry, and inventory. To use the MHS, an application appends its message with an 18-line ASCII header specifying destination name, work group, message content type, originating application type, ID number, attachment file names, and other control information. This message header serves as a routing slip that is parsed by one or more MHS servers during the routing and delivery process. Applications using MHS can extend headers by adding application-specific fields that enable more sophisticated delivery patterns and store-and-forward services.

MHS was developed by Action Technologies and licensed by Novell. NetWare 2.1 is shipped with a coupon that may be redeemed for the MHS software when available later this year. MHS is not limited to NetWare LANs; Action Technology promotes it as a universal store-and-forward engine with functionality similar to the emerging ISO X.400 standard for messaging systems. Software houses developing for MHS include Ashton-Tate, Conetic Systems, and Fourth Shift.

Data management. Advanced data-management functions are available through the use of the Btrieve API. Btrieve is a popular file and record manager developed by SoftCraft Inc. Novell recently purchased SoftCraft and has rewritten Btrieve to function as a value-added process (VAP) that is tightly integrated into the NetWare file-server environment. (For a review of Btrieve, see "A Data Manager with Language Flexibility," Burks A. Smith, October 1987, p. 104.)

Btrieve's indexed sequential access method (ISAM) package allows rapid access to database records on Novell servers. As a VAP running on the server, Btrieve offers a central file and record manager to diverse applications. It automatically performs transaction tracking and record locking and thus simplifies access to network files for applications. Used with XQL (Btrieve's implementation of SQL) and Xtrieve (Btrieve's report writer), Btrieve offers full relational database capabilities.

Network diagnostics. NetWare 2.1 provides a diagnostic API that uses IPX and SPX protocols to analyze network topology and performance. This enables a program to identify all networks attached to an internet, identify all nodes attached to the networks, and obtain information about the software components in each node. It also permits point-to-point testing to determine the location of network failure or congestion. The NetWare CARE utility, which helps network administrators monitor and diagnose LANs, is an example of what can be done with these functions.

Peer-to-peer communications. Novell has several APIs for peer-to-peer communications on the network—IPX, SPX, and a NETBIOS emulator. IPX supports the network layer of the OSI reference model and provides fast, but non-guaranteed, nonsequenced delivery of packets. SPX is a transport-layer protocol and provides guaranteed, sequenced packet delivery by means of connections between communicating stations. The Novell IPX/SPX documentation directs programmers on building data structures that will be conveyed as packets across the network. This is a low-level API for applications requiring direct, efficient access to subnet communications functions.

Novell's NETBIOS emulator uses IPX for low-level packeting and routing services. NETBIOS enhances IPX by providing guaranteed delivery and sequencing of packets, thus establishing controlled sessions between the named processes on network clients. NETBIOS allows stations to send and receive as much as 131,070 bytes of data with one call. The IPX and SPX APIs, in contrast, require data to be divided into packets of 546 and 534 bytes, respectively. (For a comparison of NETBIOS and APPC, see "Connectivity Pathways: APPC or NETBIOS," Michael Hurwicz, November 1987, p. 156.)

NetWare 2.1 has value-added processes, such as print, compile, archive, and database services, that run in a server or a bridge.

Value-added processes. NetWare 2.1 enables developers to write VAPs that can run in a NetWare file server or a bridge. VAPs provide a specialized service not offered by the operating system itself, such as print, compile, archive, and database servers.

The VAP API is a direct interface into the NetWare operating system primitives. VAPs can allocate memory in the server or bridge. They can receive input from the console or display output on it. They can spawn subprocesses (threads) and can carry on conversations with other network nodes using any of the peer-to-peer protocols. Further, because the server views them as just another logged-in client, VAPs can use most of the high-level APIs discussed above. Thus, they offer a great deal of power in extending and customizing the functionality of a network.

One caution to developers: Novell allows VAPs to hang the server. The NetWare file server is a nonpreemptive environment; therefore, it is the responsibility of third-party server processes to be reliable and return control of the server before other server tasks begin to suffer. 3Com also uses this nonpreemptive approach on its file servers (pre-LAN Manager) and thus does not protect server processes from each other's vagaries.

Program errors that cause a server to hang almost always involve one of two factors: branching into garbage areas of memory and executing the "instructions" there, and writing data to areas of memory needed for some other purpose. In particular, the interrupt vector table at 0:0 is a frequent victim of C programs that fail to trap a null pointer.

On 80286 or 80386 machines running in protected mode, these errors almost always cause trespassing on areas of memory that the program does not own, thereby generating a general-protection interrupt. Unfortunately, NetWare does nothing with the general-protection interrupt; the server just hangs. To avoid serious failures on the file server, Novell recommends that VAP applications be debugged on NetWare bridges.

Wide-area communications. APIs for wide-area communications manage links established by a bridge or gateway. NetWare LANs can be linked to wide area networks by a variety of methods, including Systems Network Architecture (SNA) gateways to IBM mainframes and minicomputers, transport control protocol/internet protocol (TCP/IP) gateways, X.25 and asynchronous bridges, and X.25 and asynchronous gateways into public and private data networks.

NetWare communications APIs provide the developer with services that configure and manage wide-area links to transfer files, query databases, and execute remote procedures. Novell has announced a number of new wide-area communications APIs, in particular a TCP/IP API and an Asynchronous Communications Services interface.

One particularly significant communications API available from Novell is APPC LU 6.2. With LU 6.2, programs running on network nodes communicate with each other without terminal-emulation software. LU 6.2 lets communicating partners pass each other only the data they wish to exchange; they are not obliged to wrap it in screen-formatting codes, as they are with other micro-to-mainframe APIs.

The Novell version of LU 6.2 requires client interface software loaded in the client and an LU 6.2 gateway component that runs in a NetWare gateway server. Both of these software elements are included with the Novell LU 6.2 developers' toolkit.

NetWare also supports the IBM 3270-APIs, LLAPI and HLLAPI, which allow applications to communicate with IBM mainframes as terminals through an SNA gateway and perform file-transfer functions. Programs developed using the IBM version of these APIs run without modification on a NetWare LAN. This is true for the LU 6.2 API and Novell's API for 5250 emulation, which is used in conjunction with a 5250 gateway connected to IBM System/3*x* minicomputers. All calls to LLAPI and HLLAPI are supported through Novell's PCOX APIs. The PCOX compatibility API (PCOX/CAPI) emulates the IRMA BASICA subroutine interface; programs written to that API can function without modification on a NetWare LAN.

APPC and the 3270 APIs require additional resident software loaded into each workstation. These interfaces can require more than 250KB for stations communicating with 3270 gateways on internets with APPC capabilities. Novell's APPC requires less memory than IBM's because much of the code can run on the gateway server.

COMPREHENSIVE CORE SERVICES

The core services are the foundation of Novell's NetWare, providing applications with essential file, print, and administrative services. Novell servers currently provide some of the highest levels of service in the industry, and the NCP API gives applications full access to the processes resident on Novell servers that make these services possible.

The following functions are included in the NCP services: accounting, bindery, connection, data synchronization, directory management, file management, file-server environment, print services, queue management, server-based communications, transaction tracking, and workstation environment.

The core services take place in the file-server operating system and are executed remotely by the workstation shells. When the shell detects a call that requires servicing by the server, it constructs an IPX-format packet containing the parameters for the server procedure. It then sends the packet to the server and waits for a response. When the server receives a request packet, it performs the indicated processing and sends the requesting station an IPX packet with the information returned by the procedure.

If the workstation receives no response within a certain amount of time, it reattempts the transmission. The time allotted is the time it takes for a round trip from the station to the server, plus the estimated time needed to service the request. Upon no response, the workstation eventually assumes that the connection with the server has broken down, and it notifies the user at the station. Table 2 lists all the NetWare functions by functional grouping.

Accounting services. A server charges users for services provided using accounting APIs. It also can provide an audit trail of network usage, even if charges are not actually billed. The server maintains an audit log in the SYS:SYSTEM/NET$ACCT.DAT file; it tracks logins, logouts, connection time, disk reads, disk writes, and disk storage. The ATOTAL and PAUDIT supervisor utilities issue primitive reports on the data stored in the file.

Among the many accounting services API function calls available are Get_Current_Account_Status, which returns the current status of an account, including the current balance, the credit limit, and any holds that have been placed on the account; Submit_Account_Charge, which charges a specified amount to an ac-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count; Submit_Account_Hold, which places a hold on an account to ensure that it can afford a requested service; and Submit_Account_Note, which enters a note in the audit log file.

Bindery services. The bindery is a special-purpose database, where NetWare stores administrative data about network resources and users. It maintains lists of *objects*—users, groups, directories, queues, attached servers, and any other named entities on the network. Each object, in turn, has identifying characteristics called *properties*.

NetWare bindery functions regulate access to the network by maintaining lists of the directories to which users have been granted rights, the rights assigned to them in those directories, the groups to which they belong, and users with whom they are security-equivalent. Applications call bindery services to determine which network objects exist and their security conditions in the course of file-server access.

Connection services. The connection functions control sessions between workstations and file servers. They perform logins and logouts, attachments and detachments, and reporting of configuration information, such as the name of the user logged in on a particular connection, the time and date when login occurred on the connection, the connection number assigned to the current workstation, the absolute network address of the node with which a given connection is established, and a list of connections on which a given user is logged in.

Data synchronization. The difference between NetWare and DOS is most apparent in the services each offers for data synchronization. DOS has one function, which allows the locking of one physical byte range within a file. NetWare has 23 data synchronization functions, including simultaneous locking of multiple files and records, thereby eliminating the possibility of a deadly embrace (a system lock-up that occurs when two applications repeatedly attempt to secure the same resources). NetWare permits files and records that are locked as a group to be unlocked, either individually or in concert. Virtual locks comprising string symbols are provided for applications to check to coordinate data access. A full set of functions for creating and manipulating semaphores is available.

NetWare allows file-related data to be locked using three units of data: entire files, byte ranges within files, and string symbols (virtual locks). Each unit has the same locking functions:

- Log/lock the unit—enters the data unit into a local log table. If only one unit is being sought, this function can be made to log and lock it simultaneously. The functions in this group are log/lock file, log/lock physical record, and log/lock logical record.
- Lock a set—attempts to lock all the resources entered in the local log table by the log/lock function. If all the resources cannot be locked, none is, and an error is returned.
- Release a single unit—unlocks a single logged element but leaves it in the local log table. Locks on any other logged units are not affected.
- Clear a single unit—unlocks a single logged element and removes it from the local log table. No other units are affected.
- Release the entire set—unlocks all units locked bv the lock-a-set function. They remain entered in the local log table so that they can be locked again, if necessary.
- Clear the entire set—unlocks all of the logged elements and clears them from the local log table. The func-

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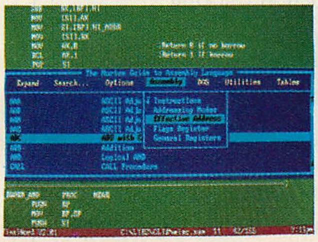
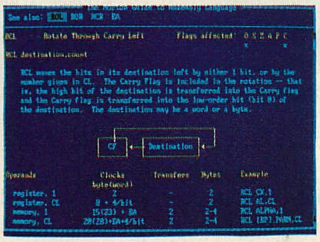


A Guides reference summary screen (shown in blue) pops up on top of the program you're working on (shown in green).



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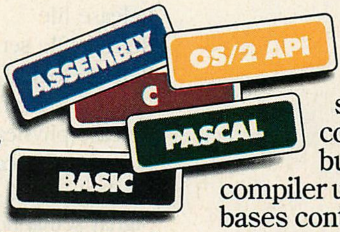

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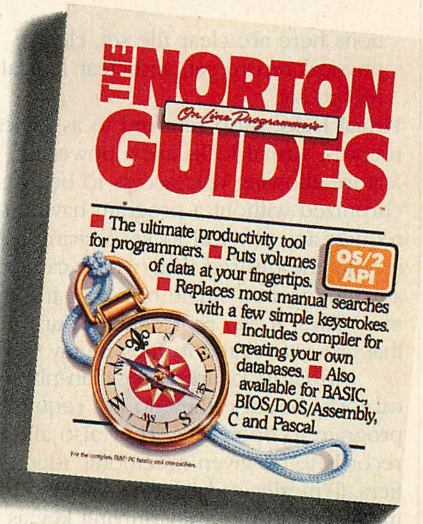

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TABLE 2: ***NetWare API Functions***

ACCOUNTING SERVICES
Get current account status
Submit account charge
Submit account hold
Submit account note
BINDERY SERVICES
Add object to set
Change object password
Change object security
Change property security
Close bindery
Create object
Create property
Delete object
Delete object from set
Delete property
Get bindery access level
Get object ID
Get object name
Is object in set
Open bindery
Read property value
Rename object
Scan object
Scan object trustee paths
Scan property
Verify object password
Write property value
CONNECTION SERVICES
Attach to file server
Detach from file server
Enter login area
Get connection information
Get connection number
Get internet address
Get object connection numbers
Get station address
Login to file server
Logout
Logout from file server
DATA SYNCHRONIZATION
Clear file
Clear file set
Clear logical record
Clear logical record set
Clear physical record
Clear physical record set
Close semaphore
Examine semaphore
Get lock mode
Lock file set
Lock logical record set
Lock physical record set
Log file
Log logical record
Log physical record
Open semaphore
Release file
Release file set
Release logical record
Release logical record set
Release physical record
Release physical record set
Set lock mode
Signal semaphore
Wait on semaphore
DIRECTORY MANAGEMENT
Add trustee to directory
Allocate permanent directory handle
Allocate special temporary
Directory handle
Allocate temporary directory handle
Create directory
Deallocate directory handle
Delete directory
Delete trustee from directory
Get directory handle
Get directory path
Get disk utilization
Get effective directory rights
Get volume info with handle
Get volume info with number
Get volume information
Get volume name
Get volume number
Modify maximum rights mask
Rename directory
Scan directory for trustees
Scan directory information
Set directory handle
Set directory information
FILE MANAGEMENT
File server file copy
Get extended file attributes
Get file system statistics
Purge erased files
Restore erased files
Scan file information
Set extended file attributes
Set file information
FILE SERVER ENVIRONMENT
Check console privileges
Clear connection number
Disable file server login
Disable transaction tracking
Down file server
Enable file server login
Enable transaction tracking
Get connection's semaphores
Get connection's task information
Get connection's usage statistics

tions here are clear file set, clear physical record set, and clear logical record set.

Virtual locks. Also referred to as logical records, virtual locks are a powerful feature allowing data access to be synchronized without a program having to request any physical locks. A string represents the desired data, which can be anything from a single byte in a file to many files. It can represent resources that are not related to files in any way.

Virtual locks are faster than physical locks because they do not require a program to open files. They also allow records to be given mnemonic identifiers. Typically, a database application might use a unique identifying key as a record string—a social security number or a last name/first name combination. All stations must use the same algorithm for generating the symbol string and checking it before file operations. The danger is that because virtual locks place no actual locks on a file, programs that do not respect them can go into a file and enter data at will.

Semaphores. These functions are similar to logical record locks in that they do not work unless all stations competing for access to a resource agree to use them. They are based on symbol strings, which must be computed the same way by all cooperating stations.

Semaphores generally are used to control access to limited resources. When a semaphore is opened, it is assigned an initial value, which indicates how many resources of a given type are available. Only the first open affects the initial value of the semaphore; after that, its value is changed by waiting on the semaphore, which decrements it, and signaling the semaphore, which increments it. If a wait command makes the value negative, the requesting station is kept waiting until a signal call received from another station sets the value back to zero. NetWare's functions for manipulating semaphores are open, close, signal, wait, and examine.

Directory management. This group of functions uses a directory handle to simplify directory access and to control the mapping of drives to directories, similar to the file handle used for file access. By associating a one-byte handle with a directory, programs use it instead of a lengthy file name.

The directory-management functions map logical drives to network directories and create, delete, and rename directories. They get and set a directory's status information, such as the date and time the directory was created, the object ID of the directory's

FILE SERVER ENVIRONMENT *(cont.)*
Get disk channel statistics
Get drive mapping table
Get file server date and time
Get file server description strings
Get file server information
Get file server login status
Get LAN driver's configuration information
Get list of connection's open files
Get list of connections using a file
Get logical record information
Get logical records by connection
Get object's remaining disk space
Get physical record locks by connection and file
Get physical record locks by file
Get semaphore information
Get server LAN I/O statistics
Get server misc information
Get transaction tracking statistics
Purge all erased files
Read disk cache statistics
Read physical disk statistics
Send console broadcast
Set file server date and time

PRINT SERVICES
Cancel LPT capture
Cancel specific capture
End LPT capture
End specific capture
Flush LPT capture
Flush specific capture
Get banner user name
Get default local printer
Get default print job flags
Get printer status
Get specific capture flags
LPT capture active
Set banner user name
Set capture print job
Set capture print queue
Set default capture flags
Set default local printer
Set specific print job flags
Specify capture file
Start LPT capture
Start specific capture

QUEUE MANAGEMENT SYSTEM
Abort servicing a queue job
Attach a server to a queue
Change a job's queue entry
Change a job's queue position
Change server's rights to client's rights
Close and start a queue job
Create a queue
Create a queue job
Destroy a queue
Detach a server from a queue
Finish servicing a queue job
Get a job's queue entry file size
Get a list of all jobs in a queue
Read a job's queue entry
Read a queue's current status
Read a server's current status
Remove a job from a queue
Restore server's rights
Service a queue job
Set a queue's current status
Set a server's current status

SERVER-BASED COMMUNICATIONS
Broadcast to console
Check pipe status
Close message pipe
Get broadcast message
Get broadcast mode
Get personal message
Log network message
Open message pipe
Send broadcast message
Send personal message
Set broadcast mode

TRANSACTION TRACKING
TTS abort transaction
TTS begin transaction
TTS end transaction
TTS get application thresholds
TTS get workstation thresholds
TTS is available
TTS set application thresholds
TTS set workstation thresholds
TTS transaction status

WORKSTATION ENVIRONMENT
End of job
Get connection ID table
Get default connection ID
Get drive connection ID table
Get drive flag table
Get drive handle table
Get file server name table
Get number of local drives
Get preferred connection ID
Get primary connection ID
Get workstation environment
Set end of job status
Set error mode
Set preferred connection ID
Set primary connection ID

The complete set of Novell NetWare NCP function calls are available to applications running on a PC connected to a network. The PC must have the NetWare shell loaded into memory, and the network file server must be using Novell software.

owner, and the directory's maximum rights mask. These functions get volume information (including the disk space allocated to the volume), the number of directory entries allowed on the volume, and the number of available directory entries. They return any available information about the number of directories, files, and disk blocks owned by a user, and they add and remove users allowed access to a directory (called the *trustees*).

File management. The file-management functions provide the basic file operations—open, close, read, write, create, and delete—offered by the DOS file-handle functions (3DH, 3EH, 3FH, 40H, 3CH and 5BH, and 41H). Programs that use these functions exactly as they would with DOS. Other functions specific to NetWare offer network-specific file operations.

The set-extended-file-attributes function specifies how .COM and .EXE files search the network path for data files they need; a transactional flag, which causes the transaction-tracking system (TTS) to protect the file; and the indexing flag, which causes the server to use an indexed file allocation table (FAT) for the disk areas where the file is located. This is much faster for large files than the normal sequential search of the FAT.

Get_file_system_statistics reports the number of open files, open indexed files (configured maximum, number in use, peak number actually used), and read and write requests received by the server.

File_server_file_copy copies a file on the server to another file on the server without loading it into the workstation's memory.

The purge-and-restore-erased-file functions come into play after a user deletes a file. The file is not initially deleted; instead, the file is marked for deletion. The file is permanently deleted the next time the user deletes or creates another file or issues a purge command.

A file can be recovered if it has not been purged. Functions for setting and getting file information include parameters such as creation date, last access date, last modification date and time, last archive date and time, file size, and file owner.

File-server environment. The file-server environment (or virtual console) functions enable system supervisors to query file-server system data from a workstation. The FCONSOLE utility incorporates these functions, which return statistics on file usage and record

locks (by station or file name) and information on the TTS, LAN-driver configuration, and volume usage.

Print services. The print-service functions permit redirection of local printers to network printers and detailed print-job configuration. The redirection functions cause all print output to be captured in a spool file, which then is placed in a print queue.

The configuration functions control the following parameters: the user name printed on the banner page, the print queue that receives a spooled print job, the number of spaces to which tabs are expanded, the number of copies to be printed, the type of form on which a job is to be printed, which printer attached to the server will print a job, the capture time-out, and the maximum number of lines per page and characters per line.

Queue management. One of the most versatile features added to NetWare 2.1, queue management enables programs to create and destroy queues, send jobs to queues, and attach servers to queues. The file server keeps track of service queues as bindery objects with the Q_DIRECTORY property, which specifies the directory in which the files associated with this queue are placed. A unique *type* is associated with the function of a specific queue: type 3 (print), type 5 (job server), and type 10 (archive server).

In addition to Q_DIRECTORY, queues have three other properties. Q_SERVERS lists all servers authorized to service queue entries; Q_USERS lists users who are allowed to submit jobs to the queue for servicing; and Q_OPERATORS lists users authorized to delete jobs in a queue, change the priority of currently queued jobs, or perform other queue-management jobs.

Server-based communications. NetWare's two methods for medium-volume, low-speed communications are *broadcast messages* and *message pipes*. Broadcast messages are received from other users across the bottom of a workstation's screen. Because programs can turn off screen display of messages and intercept the messages themselves, they can be used (in a limited way) for program-to-program communications.

Message pipes are more powerful. They require that a pipe be opened between two stations, then permit as many as six messages (of up to 126 bytes) to be queued at the communicating stations.

Pipes and broadcasts are not peer-to-peer communications—they must pass through the file server. IPX, SPX, and NETBIOS should be used for communications that require greater speed or that have more data to transmit.

Transaction-tracking system. As PC-based LANs have become increasingly integrated into enterprise-wide data-processing systems, the demand for data protection and security also has increased. System fault tolerance (SFT), introduced with NetWare 2.0, addresses this need, and TTS is its most important element. By specifying to the file server that files are transactional, a programmer can direct TTS to guarantee that all writes to those files be per-

NetWare's queue management system lets programs create and destroy queues, send jobs to queues, and attach servers to queues.

formed completely or not at all. Thus, if either the workstation or file server fails during the transaction, the files are returned to their previous state.

To use the implicit mode of TTS, a program need do no more than flag the files. Once the number of locks requested exceeds the lock threshold (which defaults to 1), TTS initiates a transaction automatically. The explicit mode allows the program to control transaction tracking and encourages developers to group file updates as transactions. The program issues specific begin and end calls to indicate where transactional file updates occur.

While transaction tracking is in effect, NetWare automatically locks records before performing writes to them. It also keeps locks in effect even after the program has explicitly released them, under the assumption that it is not safe to release the locks until the transaction completes.

Workstation environment. With these functions, a program can set and get information on such factors in the local workstation environment as end-of-job status, error-reporting mode, server attachments, and drive mappings.

The workstation shell automatically makes an end-of-job call whenever a program exits. If the program has disabled the end-of-job, it can make the call itself. The end-of-job call resets the workstation environment to its state before the program gained control: it clears all locks, closes all open files, and resets the lock and error modes.

NetWare has three modes of reporting I/O errors. Mode 0 displays the error message on the screen for user intervention. Mode 1 returns a NetWare extended error code in register AL for all I/O errors. Mode 2 returns the extended error code in register AL for critical I/O errors only.

The workstation environment functions return information about servers to which the station is attached, such as their names and network addresses. They also allow the station to switch servers. NetWare's three classifications for server attachments are primary, preferred, and default. The primary server is the first server a station logs into, unless it is changed with an explicit Set_Primary_Connection ID call. The preferred server is the one to which the workstation is currently sending packets. If no server has been so designated by a Set_Preferred_Connection ID call, the default server has preferred status. The default server is the one to which the current drive is mapped. If the current drive is a local drive, the default server is the primary server.

A NETWARE APPLICATION

The sample network application that was written as part of the research for this article transfers one or more files through the network between the local hard disks of two workstations. The program was written in C, with some assembly language; it uses both the NCP and NETBIOS calls.

The transfer application consists of NBSEND, which resides on the sending PC, and NBRECV, for the receiving PC. Listing 1 (NBSEND.C) is the source code for NBSEND. The header file (NETWORK.H) defines the data structures used by NBSEND. The source code for these sample programs was compiled with Microsoft C 5.0 and the following command-line syntax:

```
CL /AL /Zp1 /c NBSEND.C NBRECV.C
```

In addition to the C source-code files and the header file, the application requires an assembly-language file called _NCPLOCK.ASM, which fills registers with values necessary for locking files when using NCP calls. This code was assembled with the syntax:

```
MASM _NCPLOCK /MX:
```

Source code for the programs, executable files, header file, and other supporting files are available for downloading from PCTECHline. This application could be used in a variety of situa-

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tions that require file sharing among network users with local hard disks—for example, network-based programmers working on different sections of an application, who keep their source code on a local hard disk.

NBSEND and NBRECV provide an automated exchange of files; the server is used only to help establish the session. At the end of the transmission, the sender knows whether or not the receiver has received the files, and the receiver knows that only the desired files have been received. No files are placed on network drives.

One of the design decisions for this application was which peer-to-peer protocol to use to transmit files—IPX, SPX, or NETBIOS. Although IPX is a fast and efficient protocol, it provides neither guaranteed delivery nor sequencing of packets, which makes it undesirable for transmission of files. SPX offers guaranteed delivery and packet sequencing; however, it can be unwieldy for transferring large amounts of data because it requires data to be sent in 534-byte fragments. SPX also requires both sending and receiving stations to know each other's absolute network addresses.

NETBIOS, like SPX, offers guaranteed delivery and sequencing. It permits stations to address each other using a name rather than a network address. NETBIOS allows 131,070 bytes to be sent with one CHAIN SEND command and 65,535 bytes with one SEND command; it also performs all packet assembly and disassembly.

NETBIOS's main disadvantage is that it can be slow during initialization; because names must be unique across the network, all commands that use names, such as ADD NAME, CALL, and LISTEN, must query every attached station. Once a session has been established between two partners, NETBIOS is quite efficient. An even more efficient transfer could be provided by a compact, low-level, IPX/SPX routine to be called by a higher-level program—but this requires a greater development effort than deploying NETBIOS.

NETBIOS is a convenient interface for transferring large amounts of data. NBSEND uses 64,000-byte buffers. With NETBIOS, the program can send the buffer into which it reads the file and can write the buffer into which it receives the file.

The next decisions to be made for the sample application were what names the stations would use to contact each other and how each station would know the others' names. Another decision was whether the programs should operate as memory-resident routines or as executable files requiring full control of each station. Most memory-resident programs are invoked by an interrupt; if the interrupt occurs while DOS is servicing an INT 21H request, subsequent calls to INT 21H from the memory-resident program may hang the computer. Because the main purpose of the sample application is file transfer using INT 21H calls to read and write the files, a memory-resident approach would be inappropriate and ineffective.

NetWare broadcast messages synchronize the activity of the sample application programs. NBSEND sends a broadcast message to the receiver, asking if it can receive files from the sender. The receiver then sends a yes or no broadcast message back to the sender. If the answer is yes, NBSEND proceeds with the file transfer.

The programs use several NCP functions to query the environment and lock the files. High-level interfaces to the NCP and NETBIOS functions are provided by external functions defined in the files NCPLIB.C and NBLIB.C. Figure 1 is an example of one of the functions in NCPLIB, NetGetStationNumber. This function calls NetWare function DCH to get the station number of the current workstation. DCH is a simple function, passing one parameter (the function code) in AH and returning one value (the station number) in AL.

Many of the NCP calls use data structures referred to as *request buffers* and *reply buffers*. The format of these structures varies for each function, but several fields are common. The first field in the request buffer contains the length of the buffer as a two-byte integer; the second field is a byte containing a subfunction number.

The first field in the reply buffer is always the length of the buffer, also a two-byte integer; it may be zero. Pointers to the request and reply buffers are passed in DS:SI and ES:DI, respectively. The functions in NCPLIB use **intdos** to invoke INT 21H.

Figure 2 shows the functions in NBLIB.C. The NbSend library function sends a buffer of data by calling the _NetBIOS function, also listed. These functions use the NCB data structure, defined in the header file. This is the

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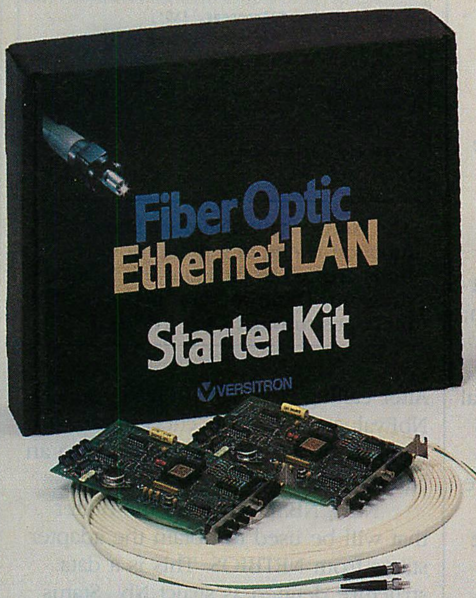

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network control block (NCB) defined by IBM for passing parameters to and from NETBIOS. All the functions in NBLIB except NbEvaluateRetcode issue the NETBIOS command with the corresponding name, and they work the same way: by filling the required fields of the NCB, then calling _NetBios, which places the segment address of the NCB in ES and its offset address in BX, then using **int86** to invoke INT 5CH. NbEvaluateRetcode examines the return code of each NETBIOS call, and, if an error has occurred, prints the appropriate message and terminates the program. The syntax for NBSEND and NBRECV are as follows:

C > NBSEND ⟨target user⟩ ⟨filespec1⟩ . . . ⟨filespecN⟩]

C > NBRECV ⟨target user⟩ [⟨target directory⟩]

If ⟨target directory⟩ is not specified, the current directory is used. The filespecs can contain full path names and wild cards. NBRECV is essentially a mirror image of NBSEND: when NBSEND performs a send, NBRECV performs a receive; when NBSEND performs a call, NBRECV performs a listen; and when NBSEND performs a read, NBRECV performs a write.

NBSEND consists of three principal sections—initialization, loop, and closing. The initialization section allocates needed buffers, validates command-line parameters, registers the user name with NETBIOS, sends a message to the target user, waits for a response, and establishes a session. The loop section cycles through the file names entered and sends each one to the receiving partner. The closing section notifies the receiving partner that the transmission is complete, terminates the session, releases the buffers, deletes the user name from the NETBIOS table, informs the user of the status of the transmission, and exits.

After declaring its local variables, checking the command-line parameters, and allocating the file-transfer buffer, NBSEND calls the NBLIB function NbReset to reset the NETBIOS parameters. The arguments to NbReset are:

- A pointer to an NCB, in this case, MnbResetNCB.
- The number of concurrent sessions desired for this station—a 0 indicates use of the default, which is 6.
- The maximum number of outstanding NCB commands desired—again, 0 indicates the default, which for Novell's NETBIOS is 32.
- The LAN adapter number—0.

FIGURE 1: *Station Number*

```
/*******************
*
* NetGetStationNumber
*
* Get logical station number of current station
*
* SYNTAX:  stationNum = NetGetStationNumber();
*
*          int stationNum;
*
********************/

#include <dos.h>

int pascal NetGetStationNumber()
{
   union REGS inregs, outregs;
   struct SREGS segregs;

   memset((char *)&inregs, '\0',
                 sizeof(union REGS));
   memset((char *)&segregs, '\0',
                 sizeof(struct SREGS));
   inregs.h.ah = (unsigned char)0xdc;

   intdos(&inregs, &outregs);

   return(outregs.h.al);
}
```

The NetGetStationNumber library function is one of a group of functions created to facilitate the NBSEND program. These routines perform NCP functions through DOS INT 21H.

After calling NbReset, NBSEND calls NbEvaluateRetcode to check the return code. This occurs after every call to an NBLIB function.

Next, NBSEND clears the buffer that will be used to obtain the adapter status from NETBIOS. This is a data structure defined as struct Nb_Status in the header file. NBSEND then calls NbStatus, which uses the STATUS command to return configuration, traffic, and error information. In this case, NBSEND is interested in only one field, and for only one reason—to make sure NETBIOS is installed.

The PossibleNCBs field returns the highest number of outstanding NETBIOS commands that can be supported. The entire structure is set to zero before the call. Thus, it is safe to assume that if PossibleNCBs is still zero after the call, NETBIOS has not acted upon it and therefore is not installed.

Next, NBSEND uses some NCP calls to collect information about the sending and receiving users. The first function that it calls is NetObjectToConnections, the parameters of which are the target user name (TargetUser), the user type (NET_USER), a pointer to an integer that returns the number of stations into which the user is logged (&NumConnections), and a BYTE array that returns the target user's logged-in stations (ConnectionList). NetObjectToConnections uses NetWare function E3H, subfunction 15H (Get Object Connection Numbers). This function reports how many stations a given user—in this case, the target user—is logged in on and the numbers of those stations. The variable NumConnections returns the count of stations; if it is zero, NBSEND knows that the target user is not logged onto the network and terminates the program.

If the target user is logged on, NBSEND next calls NetGetUserName to find out the name of the user on the local station (the 0 argument means this station), and NetGetStationNumber (see figure 1) to obtain the station number. NetGetUserName indirectly uses function E3H, subfunction 16H (Get Connection Information), which retrieves the following data about a given workstation: user name, user's unique ID, user type, and the time the user logged in. NetGetUserName returns a pointer to the user name.

NBSEND calls the NBLIB function NbAddName to add the local user name to the NETBIOS name table. The arguments to NbAddName are:

- A pointer to the associated NCB.
- The adapter number, 0.
- The address of the routine to be executed on completion, known as the post routine. Address 0L means no post routine exists.
- A pointer to an integer (NameNumber1), which returns the number NETBIOS assigns to the name.
- A 1 or 0 to indicate whether the function should return immediately (WAIT_NO) or wait until it completes to return (WAIT_YES).
- A 1 or 0 to indicate whether the name is a group name (1) or a unique name (0).

Group names can be used by more than one user and are used by NETBIOS for broadcast datagrams.

If NbAddName is successful, then NBSEND returns to NCPLIB. It first calls NetSetBroadcastMode with an argument of 3. The argument is the broadcast mode desired; 3 means that the program intercepts incoming messages and does not allow them to be displayed on the user's screen. NetSetBroadcastMode uses NCP function DEH (Set Broadcast Mode). It returns the old broadcast mode to be reset later.

Next, NBSEND sends a message to all the stations where the target user is logged on. It does so by calling NetBroadcastMessage, which takes three arguments: the message (OutMessage);


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a pointer to the number of stations into which the user is logged, shown as NumConnections (this is both an input and an output parameter—it returns the number of stations that received the message); and a list of the stations to which to send the message. NetBroadcastMessage then calls NCP function E1H, subfunction 0 (Send Broadcast Message). Upon return, NumConnections is checked; if it is zero, no stations received the message and the program terminates.

If the user receives the message, the program loops for 60 seconds, while repeatedly calling NetGetBroadcastMessage to see if the target user has responded. NetGetBroadcastMessage, which requires no arguments, calls NCP function E1H, subfunction 1 (Get Broadcast Message). If no message arrives within that time, the program terminates. Otherwise, the message is scanned for a colon, and the program looks at the character two bytes past it, because the message arrives in the following format (assuming TargetUser is logged in at station 10):

From TargetUser[10]: YES

The program checks for a *Y* or *y* in that location; any other character is assumed to be no. A no answer terminates the program; a yes causes NBSEND to seek a session with the target user by calling NbCall, which takes nine parameters: the NCB; adapter number; source-user name; target-user name; send time-out expressed in half-seconds (120 time-out of 60 seconds); receive time-out expressed in half-seconds (120 time-out of 60 seconds); post-routine address, 0L; a pointer to an integer that returns the session number assigned by NETBIOS, SessionNumber1; WAIT_YES or WAIT_NO, to indicate wait or no-wait mode.

Once the session is established, NBSEND goes into a loop that performs the following actions for each file entered on the command line:

- Checks the file status. The file is examined using **stat** to make sure it exists and is not a directory.
- Locks the file. The file is locked by calling NetLockFile, which calls NetWare function EBH (Log File).
- Opens the file. Using **sopen**, the file is opened for read-only access in deny-none sharing mode.
- Reads and sends the file. In the **do {...} while (bytesread...)** loop, the file is read into the 64,000-byte buffer allocated previously. It then is transmitted directly from this buffer by calling NbSend (see figure 2).

FIGURE 2: *Library Functions*

```
/***************
*
* NbSend()
*
* SYNTAX:  retcode = NbSend(SendNCB,
*             AdapterNum, SessionNum, SendBuff,
*             BuffSize, PostAddr, WAIT);
*
*          int retcode, AdapterNum,
*             SessionNum, WAIT;
*          NCB far *SendNCB;
*          char far *SendBuff;
*          unsigned int BuffSize;
*          void (interrupt far *PostAddr)();
*
*****************/

#include "network.h"
#include <dos.h>

int pascal NbSend(NCB far *SendNCB, int
              AdapterNum, int SessionNum, char
              far *SendBuff, unsigned int
              BuffSize, void (interrupt far
              *PostAddr)(), int WAIT)
{
   memset((char *)SendNCB, '\0', sizeof(NCB));

   SendNCB->NCB_LSN = (BYTE)SessionNum;
   SendNCB->NCB_BUFFER = SendBuff;
   SendNCB->NCB_LENGTH = BuffSize;
   SendNCB->NCB_POST = PostAddr;
   SendNCB->NCB_LANA_NUM = (BYTE)AdapterNum;
   SendNCB->NCB_COMMAND = (BYTE)
                          (WAIT ? 0x14 : 0x94);

   _NetBios(SendNCB);

   return((int)SendNCB->NCB_RETCODE);
}

/***************
*
* _NetBios()--executes NetBIOS interrupt (0x5C)
*
****************/

void pascal _NetBios(NCB far *NCBPTR)
{
   union REGS inregs, outregs;
   struct SREGS segregs;
   segregs.es = FP_SEG(NCBPTR);
   inregs.x.bx = FP_OFF(NCBPTR);

   int86x(0x5c, &inregs, &outregs, &segregs);
}
```

The NBSEND function is typical of NETBIOS-oriented library functions called by the sample application. NBSEND in turn calls NETBIOS, which executes the 5CH interrupt.

The sequence of instructions in this loop demonstrates the convenience of NETBIOS for sending large files. A file can be read into a large buffer and then sent immediately. The NETBIOS API makes the send appear as one operation. Using SPX here would require a program to issue 120 sends.

After sending, NBSEND closes and unlocks the file, using the close and NetClearFile functions. NetClearFile uses NetWare function EDH (clear file). NBSEND ends the session by calling NbHangup, then calls NbDeleteName to delete the sending user's name from the NETBIOS name table.

BET YOUR BUSINESS

If it were not for looming developments in the network API world, such as Microsoft's LAN Manager, programmers could immerse themselves in the robust world of NetWare APIs and concentrate on programming. The possibility of a comprehensive network API standard from Microsoft complicates the selection of a network API.

As of this writing, LAN Manager development kits are starting to ship to Microsoft developers. The LAN Manager represents extensive new network APIs that are tightly integrated with DOS and OS/2 on client workstations. The advantage of the LAN Manager APIs is their integration with the industry-standard operating systems, allowing applications to make calls to local and remote resources without regard for low-level complexities.

Developers who are firmly entrenched in Novell's technology and have NetWare-specific projects under way would be ill-advised to halt development until LAN Manager meets their needs. Developers who launch new projects during the pivotal period face more difficult choices. Although Novell most likely will support many of the LAN Manager APIs, it is questionable whether or not all of the NetWare functions can be mapped easily to LAN Manager calls. Nothing prevents applications from running in both LAN Manager and NetWare environments, but the most advanced services will not be available in the smaller subset of APIs common to all LAN platforms.

The dichotomy of LAN APIs may force companies with limited development capacities to align with either the Microsoft or the Novell architecture. Others may be able to mount parallel development efforts for each product. Either way, the present situation is certainly uncomfortable for software vendors faced with betting their business on API decisions.

Novell Inc.
122 E. 1700 South, P.O. Box 5900
Provo, UT 84601
800/453-1267; 801/379-5900
NetWare 2.1 APIs
CIRCLE 337 ON READER SERVICE CARD

Ralph Davis is senior consultant with ORI/Calculon in Rockville, Maryland. He participated in the d:BASE IV development effort.

LISTING 1: NBSEND.C

```
/**************
 *
 * NBSEND.C
 *
 * Written by Ralph Davis
 * (c) Copyright 1988 Ziff-Davis Publishing Company
 *
 * SYNTAX:  NBSEND <Target User> <Filespec> [<Filespec> ...]
 *
 ***************/

#include "network.h"
#include <stdio.h>
#include <string.h>
#include <malloc.h>
#include <sys\types.h>
#include <sys\stat.h>
#include <stdlib.h>
#include <fcntl.h>
#include <share.h>
#include <io.h>
#include <time.h>
#include <dos.h>

void main(int argc, char *argv[])
{
    char *SendBuff, *SourceUser, *TargetUser;
    int ThisStation;
    char *filename;
    struct stat FileStat;
    unsigned long FileSize;
    int File1;
    int retcode;
    unsigned int bytesread;
    int NameNumber1, SessionNumber1;
    struct Nb_Status StatusBuff;
    NCB ResetNCB, AddNameNCB, CallNCB, StatusNCB,
        DeleteNameNCB, HangupNCB, SendNCB;
    int NumConnections;
    char ConnectionList[100];
    int TransmissionNum;
    char *tempptr;
    unsigned int len;
    register int i;
    register int FilesSent = 0;
    char OutMessage[61];
    char *BroadcastMessage;
    int OldBroadcastMode;
    long ltime;
  if (argc < 3)
    {
    fprintf(stderr,
      "\nUsage:  NBSEND <Target User> <Filename> "
      "[<Filename>...]\n");
    exit(1);
    }

  /* Allocate a nice big buffer.  */
  if ( (SendBuff = malloc((unsigned int)64000)) == NULL )
    {
    perror("malloc failed");
    exit(1);
    }

  TargetUser = strupr(argv[1]);

  /* Reset NetBIOS adapter zero, requesting the default number
     of sessions and command blocks (0 indicates default)    */
  retcode = NbReset(&ResetNCB, 0, 0, 0);
  NbEvaluateRetcode(retcode);

  /* Zero out the status buffer before checking status */
  memset((char *)&StatusBuff, '\0', sizeof(struct Nb_Status));
  retcode = NbStatus(&StatusNCB, 0, "*", &StatusBuff, 0L,
                     WAIT_YES);
  /* If the PossibleNCB field of the status buffer is
     still zero, NetBIOS is probably not installed. */
  if (StatusBuff.PossibleNCBs == 0)
    {
    fprintf(stderr,"\nNetBIOS not installed\n");
    exit(1);
    }
  NbEvaluateRetcode(retcode);

  /* Find out where the target user is logged on. */
  retcode = NetObjectToConnections(TargetUser, NET_USER,
               &NumConnections, ConnectionList);
  if (NumConnections == 0)
    {
    fprintf(stderr, "\nUser %s not logged onto network\n",
      TargetUser);
    exit(1);
    }

  /* Get this station's user name and station number. */
  SourceUser = NetGetUserName(0);
  ThisStation = NetGetStationNumber();

  /* Add the user's name to the NetBIOS name table. */
  retcode = NbAddName(&AddNameNCB, SourceUser, 0, 0L,
                 &NameNumber1, WAIT_YES, 0);
  NbEvaluateRetcode(retcode);

  /* Get current broadcast mode. Set broadcast mode so
     that the target user's answer will not display on the
     screen; only this program will be able to read it. */
  OldBroadcastMode = NetSetBroadcastMode(3);
  sprintf(OutMessage, "CAN YOU RECEIVE FILES FROM %s[%-d] "
              "(YES/NO)?",
              SourceUser, ThisStation);

  /* Send a message to every station where TargetUser
     is logged in */
  retcode = NetBroadcastMessage(OutMessage, &NumConnections,
                ConnectionList);
```

NETWARE 2.1 APIs

```
if (retcode == 0 && NumConnections > 0)
   {
   /* TargetUser got the message, wait for an answer */
   time(&ltime);
   BroadcastMessage = NULL;
   while ((time(NULL) - ltime < 60L) &&
          (BroadcastMessage == NULL))
      BroadcastMessage = NetGetBroadcastMessage();
   }
else
   {
   /* Couldn't contact TargetUser--abort the program */
   fprintf(stderr, "\nUnable to contact %s\n", TargetUser);
   NetSetBroadcastMode(OldBroadcastMode);
   exit(1);
   }

NetSetBroadcastMode(OldBroadcastMode);

/* Message begins with Target user name and station
   number, followed by a colon and a space.  Find
   the colon, then move 2 characters past it. */
if (BroadcastMessage != NULL)
   tempptr = strrchr(BroadcastMessage, ':') + 2;
else
   tempptr = "N";

if (BroadcastMessage == NULL || *tempptr != 'Y')
   {
   /* Either no answer was received, or the answer
      wasn't YES */
   fprintf(stderr, "%s unable to receive transmission\n",
                 TargetUser);
   exit(1);
   }

time(&ltime);

retcode = -1;

/* Try 60 seconds to establish session w/ TargetUser, using WAIT
   option. Send/receive timeouts are 1 minute (120 half-seconds). */
while ((time(NULL) - ltime < 60L) && retcode != 0)
   retcode = NbCall(&CallNCB, 0, SourceUser, TargetUser,
                    120, 120, 0L, &SessionNumber1, WAIT_YES);

NbEvaluateRetcode(retcode);

for (i = 2; i < argc; i++)
   {
   /* Pull file name from the command line */
   filename = strupr(argv[i]);

   /* We'll use the size of the file to determine how
      many bytes to read in */
   retcode = stat(filename, &FileStat);
   if (retcode)
      {
      perror(filename);
      exit(1);
      }
   FileSize = FileStat.st_size;

   /* Lock the file */
   if (NetLockFile(filename) != 0)
      {
      fprintf(stderr, "Unable to lock file %s\n", filename);
      continue;
      }

   /* Open the file for shared, read-only access.
      Also, open it in binary mode so the data
      comes in as is. */

   File1 = sopen(filename, (int)(O_RDONLY | O_BINARY),
                 (int)(SH_DENYNO));
   if (File1 == (-1))
      {
      perror(filename);
      exit(1);
      }
```

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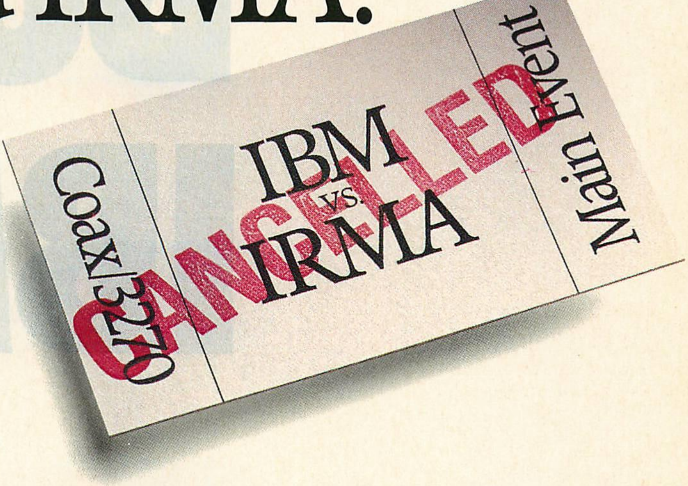

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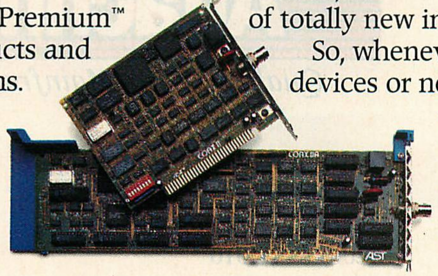

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CIRCLE NO. 165 ON READER SERVICE CARD

```
TransmissionNum = 0;

/* See if a full path or a drive letter was specified */

tempptr = strrchr(filename, '\\');
if (tempptr == NULL)
   tempptr = strrchr(filename, ':');
if (tempptr != NULL)
   ++tempptr;
else
   tempptr = filename;

len = strlen(tempptr) + 1;

do
   {
   ++TransmissionNum;

   /* If this is the first transmission for this file,
      preface the file contents with the file name */

   if (TransmissionNum == 1)
      strcpy(SendBuff, tempptr);
   else
      len = 0;

   /* If the file's too big for our buffer, read in
      64000 bytes minus the length of the filename.
      Otherwise, read in the whole file. */

   if (FileSize > (64000L - (long)len))
      bytesread = read(File1, &SendBuff[len],
                  ((unsigned int)64000) - len);
   else
      bytesread = read(File1, &SendBuff[len],
                  (unsigned int)FileSize);

   if ((int)bytesread == (-1))
      {
      perror(filename);
      exit(1);
      }

   retcode = NbSend(&SendNCB, 0, CallNCB.NCB_LSN, SendBuff,
             bytesread+len, 0L, WAIT_YES);

   NbEvaluateRetcode(retcode);
   }
   while (bytesread == (((unsigned int)64000) - len));
   printf("%s\n", strupr(filename));
   ++FilesSent;
   close(File1);

   /* Unlock the file */
   NetClearFile(filename);
   }

if (FilesSent == 1)
   printf("1 file transmitted\n");
else
   printf("%-d files transmitted\n", FilesSent);

/* Signal the receiver that we're finished */
   strcpy(SendBuff, "END OF TRANSMISSION");
   retcode = NbSend(&SendNCB, 0, CallNCB.NCB_LSN, SendBuff,
             strlen(SendBuff) + 1, 0L, WAIT_YES);
   NbEvaluateRetcode(retcode);
   free(SendBuff);

   /* Clean up */

   retcode = NbHangup(&HangupNCB, 0, CallNCB.NCB_LSN, 0L,
             WAIT_YES);
   if (retcode != 0x0a)
      NbEvaluateRetcode(retcode);
   retcode = NbDeleteName(&DeleteNameNCB, SourceUser, 0, 0L, 1);
   NbEvaluateRetcode(retcode);
}
```

Listings can be downloaded using PCTECHline, 301/740-8383. Parameters: 2400/1200/300 bps, no parity, 8 data bits, 1 stop bit.

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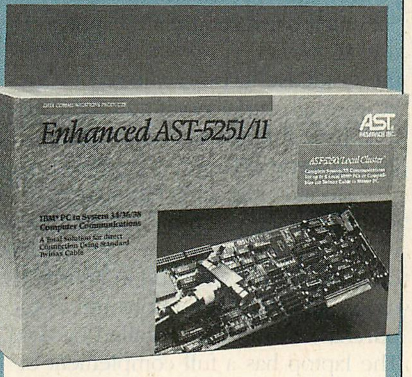

CIRCLE 341 ON READER SERVICE CARD

The past several years have seen striking changes in the way users communicate with IBM mid-range systems. Originally, System/3*x* users were stuck with only two choices: a local dedicated terminal or a remote dedicated terminal. Today, a considerably wider variety of emulation systems is available for the PC.

The AST-5250/Local Cluster from AST Research is a cost-effective way to connect four additional PCs to a System/3*x* through a gateway PC that is equipped with an AST 5250 emulation package. The local-cluster package includes all necessary software and hardware required to hook up PCs or terminals equipped with standard COM ports. AST also offers a remote-cluster package and upgrade.

The cluster is a combination of several AST products including AST-5250/11 hardware, software, file-transfer software and related manuals, a Cluster Adapter board, a four-port cable, and related documentation and keyboard templates. A quick-start booklet is included to help the user get the package up and running quickly.

The four-port cable plugs into the cluster board and then splits into four communication lines, each going to a different PC or terminal. Each attached PC (except for the cluster controller) requires only terminal-emulation software and does not require special hardware control. The cluster controller requires 235KB of memory and each attached PC requires 190KB of memory. The attached PC, however, requires an additional 60KB of memory when file transfer is used.

In addition to PCs, the cluster supports VT100-compatible terminals and the cluster software can be configured to support other types of terminals. Access to the gateway is controlled with passwords, specified for access to the configuration menus or for remote access to the host.

Each PC can access up to seven sessions, allowing users to access more than one display/printer session. Both a display session and a printing session can be active at the same time.

If desired, a standard asynchronous modem can be attached to one of the gateway ports so that remote PCs or terminals can access the System/3*x* using a modem. This appears as a local session to the host.

The gateway PC can be used for normal PC applications or as a 5250 terminal, although certain actions on this machine affect the other PCs or terminals on the cluster. For example, turning the power off or rebooting the gateway PC will terminate all sessions connected to it.

When the BASIC interpreter is used on the gateway PC, it must be started with the switch telling it not to reset the communications ports; compiled BASIC programs must be compiled with the /C:0 option. System software development should not take place on the gateway PC because this type of software often causes the PC to hang, requiring a reboot. Using program debugging tools on the gateway PC also can cause it to halt or stop normal operation.

Hardware installation is straightforward; two boards must be installed—the standard AST 5250 emulation board and the Async Cluster board. Switches must be set on the Async cluster board according to the instructions provided with the package.

Navigation through the extensive configuration program is accomplished with Lotus-style, horizontal-bar menus. AST includes all the information necessary for wiring special devices and null modems. Several appendixes are provided with the package that help in configuring non-VT100 terminals, setting up serial interfaces, and using modems in the place of PCs.

The 5250-emulation hardware included in the package is a definite improvement over previous AST versions. The emulation board has no switches to set and is lighter and less bulky. The cable thru/termination switch is a toggle switch that can be accessed from the back of the computer instead of an on-board jumper.

Several types of hot keys are available as options. For example, both Shift keys are pressed simultaneously to switch in and out of emulation. The familiar Alt-Esc sequence switches to each of the configured sessions in turn. Pressing the Alt key and the session-number key (1 through 7) at the same time switches directly to that session. Printer sessions contain special types of screens that include pertinent printer information.

A user-function menu provides access to a built-in 5251 help screen or printer status. The user also can switch between a block or underscore cursor, enable or disable the hot-key for a par-

ticular session, take a snapshot of the display screen, and redisplay a previously saved display.

Although other emulation products process the extensive 5250 attribute set somewhat slower than an actual terminal, this is definitely not the case with the AST cluster. It performs efficiently, and screen refreshes occur without any excessive delay. The AST 5250/Local Cluster provides a complete, cost-effective solution to the System/3*x* connectivity issue with a minimum investment of hardware.

—GERRY KAPLAN

GRIDCASE 1530

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47211 Lakeview Blvd.
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PRICE: $4,695

CIRCLE 340 ON READER SERVICE CARD

Since 1980, Grid Systems Corporation has specialized in building small, powerful computers specifically designed for field personnel. The company produced the first IBM-compatible laptop computer in 1981, which was also the first laptop outfitted with an electro-luminescent display. Grid still produces the only laptop computer that uses a lightweight magnesium case rather than the standard plastic case.

The GridCase 1500 series, the latest stage in Grid's line of battery-powered laptops, is composed of two models. The 1520 has a 10-MHz 80C286, and the 1530 (reviewed here) features an 80386 microprocessor running at 12.5 MHz. Grid chose the slower clock speed over the more standard 16- or 20-MHz in order to conserve power. The GridCase 1520 can use the 80287 math coprocessor and the GridCase 1530 can use the 80387 coprocessor; both models operate at the same speed as the CPU.

Each GridCase model weighs under 12 pounds and comes standard with 1MB of RAM, an LCD display, and two 1.44MB 3.5-inch diskette drives. Up to 8MB of RAM, a plasma display, a 20MB or 40MB hard disk, and internal modem are available as options.

The GridCase runs on a version of MS-DOS 3.2 specifically designed for Grid and portable-computer applications. For example, it treats the system's two optional ROM modules (one of which can contain MS-DOS) as extensions of the system disk. This makes frequently used software always available and reduces power-draining disk accesses. This special version of DOS also contains several MODE commands specifically designed for the GridCase to change screen settings.

The weakest part of the computer's design is its keyboard. Although the keys have an excellent touch, the entire keyboard is too tight and is much smaller than the standard IBM keyboard. Using only 72 keys, Grid attempts to provide all the functions of the IBM 101-key enhanced keyboard using nonstandard key combinations and unusual key placements.

The worst feature of the keyboard is the placement of both the Backspace and Delete keys in the upper right-hand corner where one key can be used mistakenly in place of the other key, causing deletions to be made from the opposite side of the cursor than the side intended. The requirement of two-key combinations for PgUp, PgDn, Home, and End is a close second in inconvenience.

In recognition of the keyboard discrepancies, the GridCase manual contains two pages of translations between IBM keystrokes and Grid keystrokes. While adjustments can be made over time, the peculiar design will continue to cause problems if the user switches back and forth between a standard keyboard and the Gridcase keyboard. Fortunately, Grid provides a standard keyboard connector for plugging in an IBM AT keyboard.

The optional plasma-display screen provides a sharp, crisp image that is readable at any angle, side to side or up and down. The mechanism that holds the screen is very solid and allows the user to tilt it to reduce glare. With a resolution of 640-by-400 pixels, the display is capable of supporting detailed graphics programs; it does get quite warm during operation, however, indicating that the power drain on the battery is substantial. A switch on the display toggles from high to low intensity, which, according to Grid, cuts the display's power consumption in half.

Two high-density 3.5-inch diskette drives that support 1.44MB or 720KB diskettes are standard on the GridCase. Options include replacing one drive with either a 10MB or 20MB hard disk or replacing both standard drives with a 40MB hard disk. With the 40MB hard disk installed, data exchange is accomplished with one of Grid's external drives, a modem, or Grid's PCMASTER/PCSLAVE software.

Both 5.25- and 3.5-inch external diskette drives are available and connect directly to the computer through a 25-pin D-shell connector, which also provides power. The system battery powers the 3.5-inch drive, but the 5.25-inch drive requires the system to use AC power. PCMASTER/PCSLAVE allows the GridCase to be connected to any PC through serial ports and then allows it to have full access and control of the PC's diskette drives.

Because the 1530 has a factory-sealed case (no screws or openings are visible for gaining access), the question of compatibility with add-in boards is moot. All GridCase options must be purchased from and installed by Grid. The laptop has a full complement of external connectors, including keyboard, CGA, serial port, parallel port, and two phone jacks (for the optional modem). All of these ports function in the normal manner.

The GridCase 1530 is compatible with all of the standard software packages in the *PC Tech Journal* compatibility test suite including Borland's SideKick 1.56A and Turbo Lightning 1.01A, Fifth Generation System's Fastback Plus 1.0., Hayes's Smartcom III 1.0, Living Videotext's Ready! 1.00E, and Microsoft Word 4.0. According to the results of *PC Tech Journal*'s performance test suite (see table 1), the machine is faster than the standard 8-MHz IBM PC/AT, but somewhat slower than the Compaq Portable 386 (although about 8 pounds lighter).

The utility of a laptop or portable computer depends, to a great extent, on the capacity and source of its power. To power the plasma screen and the 80386 processor, Compaq eschewed batteries in favor of AC power. Although Grid provides the battery option, the 1530's plasma screen, disk drives, and 80386 processor (even

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```
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_DATA   ENDS
DGROUP          GROUP   _DATA
_TEXT   SEGMENT WORD PUBLIC 'CODE'
        ASSUME  CS:_TEXT,DS:DGROUP,SS:DGROUP
        PUBLIC  _ShiftNsum
_ShiftNsum PROC NEAR
        push    bp                      ; setup stack frame with
        movbp,sp
        sub sp,2                    ; one local variable [bp-2]
        push    CX                      ; save CX used during routine
        movWORD PTR [bp-2],0 ; clear local variable
        movCx,WORD PTR [bp+4]       ; fetch number of sums
Sumlp:  movAx,[BP+6]
        shl Ax,cl                   ; double value in ax, cl times
        add WORD PTR [bp-2],ax
        loop    Sumlp
        movAx,WORD PTR [bp-2]       ; return value in ax
        pop CX                      ; restore cx
        movsp,bp
        pop bp                      ; restore stack and return
        ret
_ShiftNsum endp
_TEXT   ends
        end
```

The old way: slow, cumbersome coding.

```
        .MODEL  SMALL,C
        .CODE
ShiftNsum   PROC    USES cx, Number:Word, sums:Word
        LOCAL   sumresult               ;declare a stack local
        movsumresult,0              ; clear sumresult
        movCx,sums                  ; fetch number of sums
Sumlp:  movAx,number
        shl Ax,cl                   ; double value in ax cl times
        add sumresult,ax
        loop    Sumlp
        movax,sumresult             ; return value in ax
        ret
ShiftNsum   endp
        end
```

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TABLE 1: ***Compatibility and Performance Tests***

	8-MHz IBM PC/AT 80287, 30MB DISK[a]	20-MHz COMPAQ PORTABLE 386 80387, 40MB DISK	12.5-MHz GRIDCASE 1530 40MB DISK
ATBIOS			
ROM BIOS date	11/15/85	07/02/87	03/17/88
ATPERF			
Average RAM instruction fetch (μs)			
BYTE	.25	.15 (167)[b]	.24 (104)
WORD	.403	.10 (403)	.17 (238)
DWORD	N/A	.12	.34
Average RAM read time (μs)[c]			
BYTE	.401	.11/.20 (378/192)	.34 (120)
WORD	.401	.11/.20 (378/192)	.34 (120)
DWORD	N/A	.11/.20	.34
Average RAM write time (μs)[c]			
BYTE	.401	.10/.20 (384/192)	.34 (118)
WORD	.401	.10/.20 (384/192)	.34 (118)
DWORD	N/A	.10/.20	.34
Average ROM read time (μs)			
BYTE	.401	Same as RAM read	.51 (79)
WORD	.401	Same as RAM read	.51 (79)
DWORD	N/A	Same as RAM read	1.01
Average EMM read time (μs)[d]			
BYTE	.402	.11 (378)	.34 (120)
WORD	.402	.11 (378)	.34 (120)
DWORD	N/A	.11	.34
Average EMM write time (μs)[d]			
BYTE	.402	.10 (384)	.34 (118)
WORD	.402	.10 (384)	.34 (118)
DWORD	N/A	.10	.34
Average CGA video write time (μs)[e]			
BYTE	1.208	1.05 (115)	1.20 (100)
WORD	2.415	2.10 (115)	2.40 (100)
DWORD	N/A	4.20	4.81
CPU clock rate (MHz)	8.0	20.0 (250)	12.5 (156)
Math coprocessor clock rate (MHz)	5.3	20.0 (377)	12.5 (if present)
Refresh overhead (%)	7.1	16.0	6.0
RAM read/write wait states	1/1	0/0	2/2
ROM read wait states	1	Same as RAM read	4
Video write wait states (CGA)	8	19	13
EMM read/write wait states	1/1	0/0	2/2
ATFLOAT			
Performance relative to AT (%)	100	780	0.3
ATDISK			
Sectors/track	17	17	17
Heads	5	5	5
Cylinders	731	978	975
Total disk space (MB)	31.81	40.59	40.47
Track-track seek time (ms)	6.0	1.9	5.9
Average seek time (ms)	37.1	26.5	26.9
Effective transfer rate (KB/sec)	170.1	255.0	255.0
DOS file I/O with/without cache (sec)[f]	7.3	5.1/6.6	9.7
Interleave	3	2	2

[a] *The figures for the IBM AT are the average results from several machines; the results from the GridCase 1530 were taken only from the review unit.*
[b] *Figures in parentheses are the relative performance expressed as a percentage compared with* PC Tech Journal*'s baseline machine, the 8-MHz, 30MB AT.*
[c] *For the Portable 386, the first number is for memory access within the same 2KB page; the second is for access not within the same page.*
[d] *For the Portable 386, EMM measurements were taken using extended memory and the EMM driver provided with the system.*
[e] *For the Portable 386 and GridCase 1530, video write times were measured using the internal video controller in CGA mode.*
[f] *Portable 386 was tested with/without disk caching program.*

Although it does not offer the performance of the Portable 386 or many 386 desktop computers, the GridCase 1530 offers a fully functional 386 in a laptop. The poor ATFLOAT performance is a result of the lack of a 80387 chip in the review model.

TABLE 2: *Power Usage*

COMPONENT	POWER USAGE
GridCase 1530	4.0
80387 coprocessor	1.5
LCD back light	2.0
9.4-inch plasma display	4.5–11.3[a]
10-inch plasma display	6.0–12.0[a]
2MB system RAM	1.0[b]
4MB system RAM	0.6[b]
8MB system RAM	2.2[b]
1,200 bps modem	2.8
2,400 bps modem	0.5
3.5-inch diskette drive	1.4[c]
10MB hard disk	3.5
20MB hard disk	3.5
40MB hard disk	7.0

All amounts are in watts.

[a] *Low figure applies when display is at minimum intensity. High figure applies when display is at maximum intensity.*

[b] *These are net figures, that is, the amount by which power consumption for these configurations exceeds power consumption of the standard 1MB of RAM included in the base configuration.*

[c] *This applies only when the drive (either internal or external) is actually in use.*

Power-consumption figures supplied by Grid Systems

GridCase 1530 with a plasma display and 40MB hard disk makes short work of a 20 watt-hour battery.

at 12.5 MHz) use a lot of power. See table 2 for a list of options and approximate power consumption.

Grid says that with a fresh battery, the computer can operate for about an hour with a plasma screen and a 40MB hard disk. Experience with the review machine, however, indicates that this duration is optimistic. The battery-low indicator light generally lit up after 20 to 30 minutes of word processing and some performance tests.

Two types of batteries are available: an internal battery pack with a capacity of 20 watt-hours, and an optional external pack with a capacity rated at 54 watt-hours. The standard battery charger is also the AC power supply and fits into the battery-pack socket on the unit.

With the plasma screen, however, the power consumption is so great that the charger pack becomes almost too hot to touch, and definitely too hot to have inside the computer casing. In fact, the charger pack must be used outside of a Model 1530 casing that is equipped with a plasma display screen. Grid makes note of this problem in an errata sheet for its operations manual, but there is no mention of it in the manual itself.

The GridCase 1530 offers good performance as long as its battery lasts. It provides better performance than an AT in a slim, 11-pound package. Grid has used some innovative design features to compress all the GridCase's capabilities into such a small package. For a small, rugged laptop computer, the GridCase is a competent machine.

It does, however, have two near-fatal flaws. The nonstandard keyboard should be redesigned. It requires significant relearning and reorientation in order to prevent the numerous keystroke errors experienced in reviewing this machine.

The second flaw is GridCase's rate of power consumption, particularly with the plasma screen. The 30-minute life experienced during testing is unacceptable. Battery technology is not yet ready for laptop plasma displays. Although the plasma display is enticing, leave it home until improved batteries are available.

—DAVID CLAIBORNE

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1 OS/2 MENU

2 TSR INFO

The two items this month are a study in contrasts. The first deals with a relatively trivial problem in a new, complex environment—the customizing of the program selector menu in OS/2. The second item relates to one of the most complex problems in an old, simple-minded operating system—the implementation of a limited form of DOS multitasking by means of terminate-and-stay-resident (TSR) programs.

1 MODIFYING THE OS/2 MENU ORDER

Until the Presentation Manager comes along, the primary user interface of OS/2 is the program selector, a text-based menu system for starting programs. The selector presents two menus. The left side of the screen, titled "Start a Program," holds a list of programs that can be executed; the right side, labeled "Switch to a Running Program," displays a list of programs currently running. (See "Enter OS/2," Ted Mirecki, November 1987, p. 52.)

Program names can be added to the left-hand list at will, but experienced users may find it easier to type a name on a command line than to select it from a list. The protected-mode command-line interface is started by choosing the entry "OS/2 Command Prompt" from the left-hand menu.

The entries on the "Start a Program" menu are sorted alphabetically by program name. As new names are added to the list, the "OS/2 Command Prompt" entry will move down off the screen if more than 10 entries are added above it (the menu can be scrolled to bring subsequent pages into view). This is inconvenient for users who start the command interpreter more often than any other program.

The program selector's update procedure (activated by pressing F10) allows changing the name of a program on the list, so it seems reasonable to use that procedure to rename the command-prompt entry so it always sorts to the top of the list. That attempt produces the message "The OS/2 Command Prompt cannot be changed." If this sounds more like a challenge than a warning, read on.

The contents of the program selector menus are kept in two files named SHELL11F.AII and SHELL11F.AIF. They contain the program names in the order they were entered, and an index list indicating the sorted display order. The program selector recognizes the command interpreter by position (it is the first entry), not by name, so the name can be arbitrarily changed with some program other than the program selector itself. Because the SHELL11F.* files contain a mixture of binary and text data, a debugger is better for this purpose than a text editor.

The most convenient way of patching these files is with a DOS debugger. You can choose to boot DOS or run SYMDEB in the DOS box of OS/2; DEBUG does not run in the box because it checks for a specific DOS version. Load one of the SHELL11F files into the debugger and display it. At the offset where the "OS/2 Command Prompt" string begins, enter some other name that begins with a low ASCII character, such as a space. The most logical entry is the same string shifted to the right by one byte. The final result must be a name no longer than the original name plus its trailing spaces (displayed as 20H). Write out the file, then repeat the procedure with the other SHELL11F file. (The names are at different offsets in the two files.)

The name change takes effect the next time you boot OS/2. When the program selector appears, the command processor shows up in the list with its new name but in its previous position. If this puts it out of alphabetic sequence, perform the "Change Program Information" procedure on the name immediately above the command processor's entry. You need not actually make any changes to that program's information. Upon exit from the update procedure, the command processor's name will move up the list by one position. Repeat this procedure with each succeeding program name above the command interpreter's name, until the list is ordered correctly.

2 NEW TSR DOCUMENTATION

Over the years, DOS programmers have discovered many undocumented services used by the operating system for its own purposes. Many of these internal services have found their way into various system-level utilities, especially TSR programs. Information about them has been disseminated by a variety of sources (especially bulletin boards), but none of it was officially acknowledged by Microsoft or any other DOS vendor.

According to Microsoft, the reason for the lack of official documentation was not to hide anything from developers, but to allow the flexibility of changing these internal services in successive versions of DOS. Once a DOS feature is documented, it must be supported in subsequent versions in order to accommodate programs that use it.

Now, however, the silence is broken by a source that is considerably more official than the bulletin boards, articles, and books that previously passed along such information. That source is *The MS-DOS Encyclopedia*, edited by Ray Duncan and published by Microsoft Press. It is a hefty tome of 1,570 pages, selling for an equally hefty price of $135. Contributors include some of the major developers of DOS at Microsoft, and even Bill Gates, Microsoft chairman, wrote the introduction. As a result, *The MS-DOS Encyclo-*

pedia can be considered more as official documentation than as another after-market, how-to book.

The chapter on TSR programs gives considerable information on some of the undocumented DOS services most useful to resident utilities. None of this is entirely new, so the significance of its publication lies not in the information itself but in the fact that it is finally brought together in one authoritative source. Still, Microsoft disclaims any commitment to on-going support of these functions in future versions of DOS. The following is a summary of the information given in this chapter that is not available in the official documentation—Microsoft's *MS-DOS Programmer's Reference* and IBM's *DOS Technical Reference.*

Four previously undocumented interrupt 21H functions are listed in table 1. Strangely, function 34H is the only one of these listed in the reference section of the encyclopedia; the other three functions (and interrupt 28H described below) are mentioned only in the TSR chapter.

Function 34H returns in ES:BX the address of the InDOS flag, a byte that is incremented at every interrupt 21H and decremented at every return from the interrupt. A nonzero value at this address indicates that a DOS function is in progress, but does not indicate which function.

In DOS 3.1 and later, the critical-error flag is located in the byte preceding the InDOS flag, so function 34H can also be used to locate this flag. For reasons explained below, DOS sets the error flag to a nonzero value just before executing interrupt 24H, the critical-error handler.

Function 51H of interrupt 21H returns in register BX the program segment prefix (PSP) address of the current foreground process; it is identical to function 62H, which is officially documented. Function 50H performs the inverse operation, setting the current PSP to the address in BX. DOS uses the PSP to maintain certain data unique to each program, such as the address of the program's environment. When a TSR wants DOS to use its own PSP rather than that of the interrupted program, it can obtain the current address with function 51H, save it, reset it to its own value with function 50H, and then, when exiting, restore it to the original value with another call to function 50H.

Function AX = 5D0AH of interrupt 21H (available in DOS versions 3.1 and later) sets the extended error information that is returned by the next call to function 59H. DS:DX must point to an 11-word structure containing the error information for function 59H; on a subsequent call to function 59H, the contents of the first eight words are returned in registers AX, BX, CX, DX, SI, DI, DS, and ES, respectively. The last three words of the structure are reserved and must be zero.

The purpose of this function is to save and restore the error information of the foreground program. A TSR should obtain and save the current extended error information before calling any DOS functions and restore this information afterwards. This prevents the TSR's error information from replacing that of the foreground process, in case the TSR is activated in the interval between occurrence of an error and the retrieval of error information by the foreground process.

A final TSR-related service mentioned in the encyclopedia is interrupt 28H. It is called at each iteration of any polling loop within functions 01H through 0CH of interrupt 21H, such as when DOS is waiting for a keystroke. The default interrupt 28H handler is a bare IRET, so it normally does nothing. A resident program, however, could substitute its own handler to perform useful work while DOS is waiting for some event. For example, PRINT.COM, the DOS print spooler, installs an interrupt 28H handler that sends characters to the printer during idle time. Because this interrupt could be used by more than one process, a handler must exit by chaining through to the previous interrupt address.

Besides the description of undocumented DOS interrupts and functions, *The MS-DOS Encyclopedia* also gives information on stack usage during DOS processing. DOS is not reentrant, so a TSR cannot indiscriminately issue DOS calls because another DOS call might be in progress when the TSR is activated. Knowing the general pattern of DOS stack usage can simplify greatly the task of implementing TSR programs that must execute while DOS functions are pending.

DOS uses three different stacks. The character device I/O functions, 01H through 0CH of interrupt 21H, use one of two stacks depending on the state of the critical-error flag. Most of the other functions use a third stack. Exceptions are functions 50H, 51H, and 62H (get/set PSP address), which use the caller's stack, and function 59H (get extended error information), which behaves like the character I/O functions in version 3.0 and always uses the error-state stack in later versions.

This stack usage makes DOS partially reentrant. Character device I/O functions can be in progress concurrently with higher-numbered functions, and an error handler can perform character I/O even if a previous character I/O function caused the error. Note, however, that DOS has no built-in facility for determining which of the three stacks is in use at any given time. Such a facility could be provided by a TSR that hooks interrupt 21H, saves the function code and the state of the error flag on each entry, and then calls the previous interrupt address.

At this stage in the lifetime of DOS, this type of information serves as a record of common practice rather than a prescription for new development. With OS/2 providing a much more capable platform for multitasking, migration to the new environment will simplify most of the complex multi-thread processes.

TABLE 1: ***Undocumented TSR-Related DOS Functions***

FUNCTION NAME	ARGUMENTS	RETURNS
Get InDOS flag	AH = 34H	ES:DI points to InDOS flag address
Set PSP address	AH = 50H BX = PSP segment	Nothing
Get PSP address	AH = 51H	BX = PSP segment
Set extended error information	AX = 5D0AH DS:DX = address of 11-word data structure (see text)	Nothing

The interrupt 21H functions described in *The MS-DOS Encyclopedia* published by Microsoft Press are not documented in official reference manuals. Microsoft does not guarantee support for these functions in future versions of DOS.

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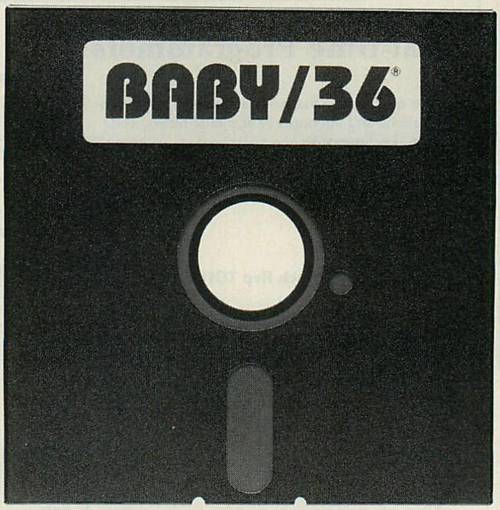

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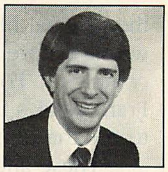


Long Dazed Journey into Bytes

Managing large collections of text is an important new application, but the tools—like a lot of off-the-shelf software—come up lacking.

I recently did a study of PC status and direction for a company with several hundred machines. It included, among other activities, 25 hours of interviews with people at all levels of the company. The resulting notes, after expansion into human-readable form, came to more than 18,000 words.

I needed to review my notes by topic to develop my conclusions and recommendations; I also wanted to use relevant quotations from these notes in my report to the client. This was a good time to try some software that had been on my shelves for months—programs that attempt to meet the growing demand for free-text analysis, a long-standing interest of mine.

The results were disappointing, but not because of problems with this particular task. Rather, the problems are general and of a kind too often encountered in PC software: specifically, poor reliability and too much user intervention. These make the user choose between the risk of new software and the safety of simpler but familiar tools. They create the dilemma of whether to risk the unpredictable amount of time needed to learn new software or, instead, to piece together your own solution with the tools you already know how to use.

DOWN MEMORY LANE

To address my text-management problem, I turned to three pieces of software specifically designed for free-text search and retrieval. The first, Group L's Memory Lane, is well designed for the PC environment. It runs as a terminate-and-stay-resident (TSR) utility; a hot key brings up its control panel from within any application.

Memory Lane creates an index file about one-sixth as large as the total volume of text being indexed—a small price to pay for the resulting high-speed retrievals. The designers understand that the typical PC file system looks like a busy workshop rather than a tidy library. They let you deal with this complexity by creating a text file of patterns (for example, *.EXE) that the program should ignore during indexing. This allows you to index source files without wasting time and space indexing the .EXE files.

When you hot-key into Memory Lane, the Search command brings up a list of files meeting the search specification; function keys handle tasks such as jumping to the next occurrence of the search phrase in a file or moving on to the next file. The process is fast, with reasonable options available at every point; the design helps you understand what's happening.

What makes these pyrotechnics useful is that you can then mark an area of the file, jump back to your original application, and paste the marked text into whatever you were doing—whether it be editing code or writing a report. When it works, it's wonderful; reports of a new release of Memory Lane sound even better.

GET IT TOGETHER

So what don't I like? I don't like the bunch of little files that comprise Memory Lane. They simplify the task of keeping memory consumption down, which is important in a TSR application, and they certainly make customization easy. For example, I approve of being able to edit the list of path names to be excluded by using a simple text editor, rather than going through an elaborate (and often inflexible) configuration utility.

At one point, however, I was rudely surprised by the on-screen message, "Fatal error reading file ML.TT." ML.TT is a translation table (whatever that is), and my text editor has no trouble reading it; furthermore, the DOS COMP utility says that the file is identical to the copy on the distribution disk. The program even seems to be creating a usable index of the specified files, despite the stern language of the error message. So, do I have an error, or don't I?

Make no mistake, I like Memory Lane. It just makes me uncomfortable to work with software—and by that I mean all PC software, not just this one product—that is so fragile.

Such fickle behavior is far too common. I have vented my wrath on past occasions about Ashton-Tate's Framework II—my favorite PC application—and its unfortunate insistence on doing "destructive saves" that wipe out

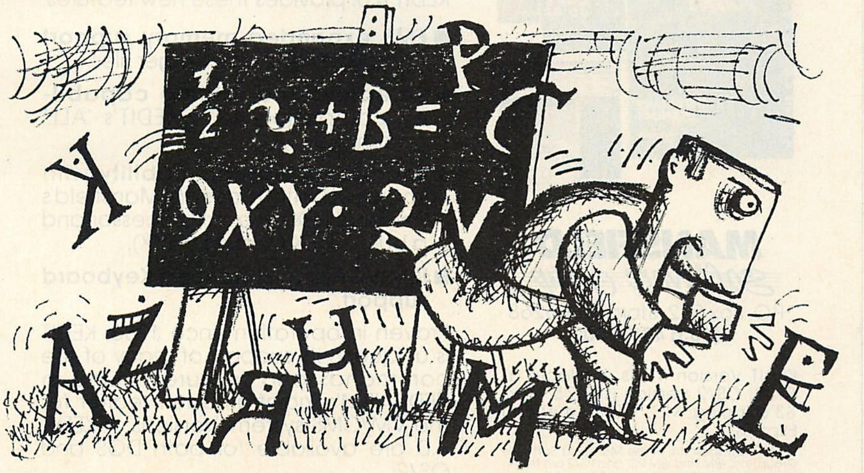


ILLUSTRATION • MACIEK ALBRECHT

the original file if something goes wrong before the save operation is completed. For reasons that are not Framework's fault, this has happened to me three times.

These and many similar experiences with other applications have put the file-system interface high on my list of concerns in evaluating any application. When we are talking to disks, I want belt-and-suspenders design all the way. What's in memory is just work in process, but what's on the disk is the result that I have bought and paid for. I want my software to have the same respect for my work.

How about providing three progressive levels of safety: no backup, backup on load, and backup on save? This would let me risk losing everything in the first case, losing the entire session (but no more) in the second, or losing only the changes that were made since the last save in the third.

For that matter, how about taking the time to show file-save progress with an odometer-type or bar-graph display? I often work with large files, a megabyte or more in size, and like to have some idea of whether the save is going to take another ten seconds or another ten minutes.

AND REMEMBER WHERE

A popular poster in many offices reads, "I've finally gotten it all together—but I forget where I put it." This came to mind as I wrestled with another text-management package, Laticorp's Context. Context originated as a UNIX application, and the manual attempts to serve both UNIX and DOS audiences. It does not accomplish either goal very well. You cannot simply thumb through the manual looking for headings or phrases that suggest the topic you are seeking; you have to backtrack from wherever you find yourself to make sure that you are in the appropriate version of the installation instructions.

The manual also reflects what I consider to be UNIX chauvinism. It provides a detailed description of the process by which Context can be made to index the user's files automatically at a time when the system is unlikely to be in use, but strongly implies that this capability is available only under UNIX. This has very little to do with the UNIX version of Context itself, but merely reflects a standard feature of the UNIX environment.

My own experience tells me that any DOS user who needs this capability already has it in one form or another. The language of the Context manual, however, tends to obscure the possibility of doing automatic night-time indexing under DOS by suggesting that the issue is whether or not Laticorp has provided the feature.

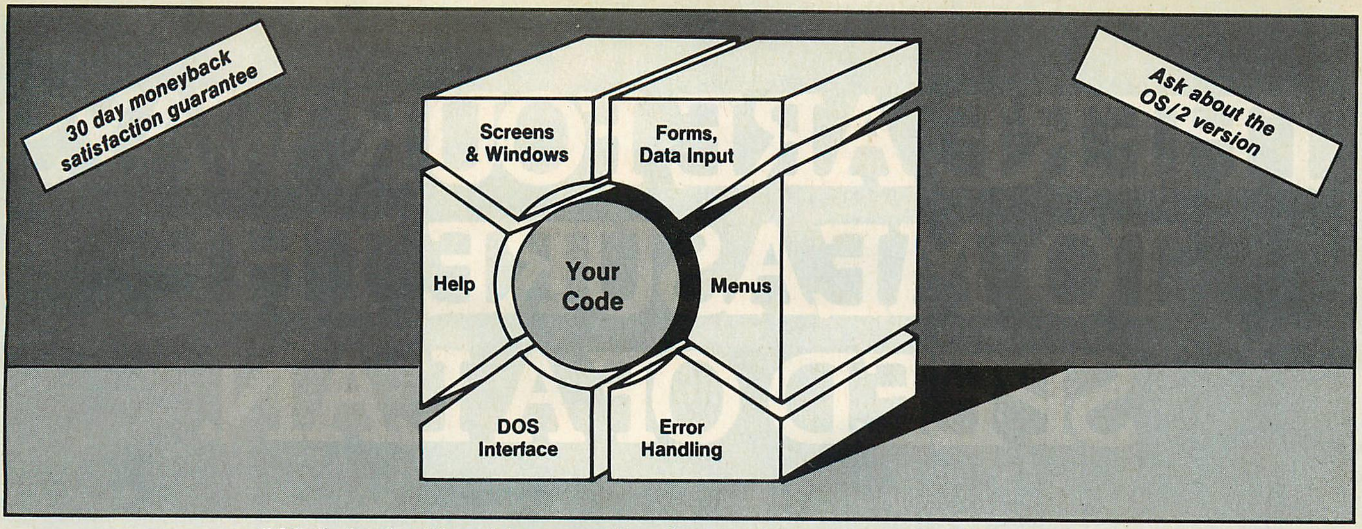
Once you proceed past the schizophrenic documentation, the Context program itself starts to act downright demented. First, it wants things done very much its own way: the user must describe so-called "collections" of files in terms of certain directories, and certain types of files in each directory (for example, ASCII or WordStar). This is the polar opposite of the Memory Lane approach, which understands that real work tends to leave files of all types in various subdirectories, grouped by attributes such as user and project, as well as by the creating application.

I went along with Context's arrogance, creating a special directory for the files I wanted to use as a test case and putting copies of them there. I told Context to install itself on my D: drive for the simple reason that C: was nearly full and index files eat up substantial disk space.

But then the dementia got worse. I told Context to create a collection, which it did with no apparent problems; when I tried to index the collection, however, the program responded that the collection does not exist. I created the collection again and received the error message, "Failed to index collection—Error Type 1." I inferred that this means the collection already exists, so I tried removing it (which works) and recreating it (which works) and indexing it again, which failed with the same error as before.

Care to guess what is happening? The program is faithfully generating the collection and related files in a CONTEXT directory, helpfully created with no notice to the user on the C: drive. This happened despite my having told it in at least three places (PATH, etc.) that its litterbox is on D:. Of course, when the time comes to index the collection, it looks in the right place—on D: (as in dementia).

The heart of the problem, again, is the file-system interface. The designers could solve the problem in either of two ways. The hard way would be to do the job correctly, so that following the manual's directions would result in the expected behavior. The easy way would be to make the program give confirming responses, such as "Created collection C:\CONTEXT\ITEMS," so that I could at least have screamed "C:?"



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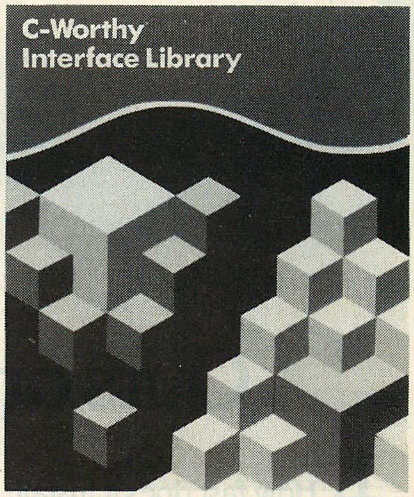

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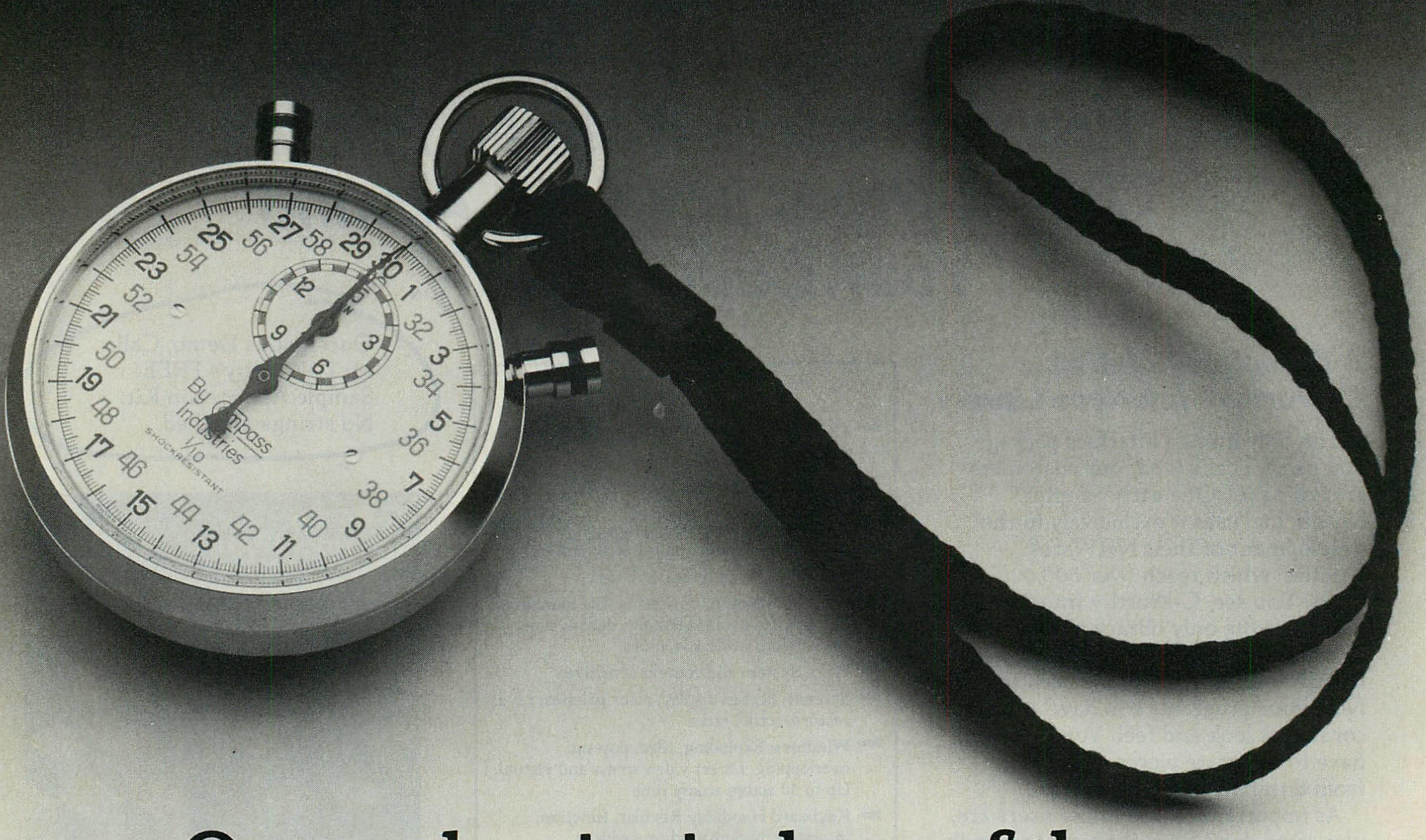

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and started tracking down the problem a whole lot sooner. Many programs, such as the WordPerfect family of editors and word processors, do this.

I find it quite reassuring to have a program say, "This is what I have done," instead of just, "OK, I did what you asked." The latter message, or the implicit message in the absence of errors, often means, "I don't know why you would want to do that, but I somehow managed to find a way to do it, so it's your funeral."

AND THEN, GIVE IT BACK

Apart from getting the pieces together, and preferably in the correct place, I also want a text-management program to return the pieces in a useful form. Memory Lane understands the PC environment, providing a cut-and-paste mechanism. Context, by contrast, merely lets you accumulate marked portions of text on either a printout or a file. This chops up what should be a simple process of reference and use.

The Context documentation alleges that you can edit the "default print command," one of several strings in a rather large file that clearly feels more at home in the UNIX environment. Since all my printing is done by way of the file system, I tried to edit this command accordingly; no matter what I did, though, Context wanted to *print* the entire file containing the target phrase, not just the marked neighborhood. It was a nice try, but simply not what I need.

At this point, I ran across an amazing third piece of software: a little program called Browser, copyrighted but apparently intended for free distribution by Mark ^Zimmermann of Silver Spring, Maryland (the caret is part of his electronic signature). Zimmermann has a well-defined mission: "I am working," he writes in the Browser documentation, "to develop tools to aid people in browsing, indexing, retrieving, and using massive quantities of free-text information."

Browser is impressive. Turn over a text file to the program, and it builds an index file. Open the index, and get a list of all distinct words occurring in the source. Select any word, and another window shows one line per occurrence with the search phrase centered—thereby giving you an idea of the local context. Click on any one of those lines, and another window opens up with the text surrounding the occurrence displayed (in its original format) in an editor window, with the size of the neighborhood being a user-defined parameter. You can also select occurrences based on the nearby occurrence of other words.

It is unbelievably neat. After looking over the specifications on The Analyst, a $2,000 program from Xerox that runs on Smalltalk workstations in the $10,000-plus class, I caught myself wondering if the bigger, more expensive program could do text searching as conveniently as Browser does on my Macintosh Plus. Browser is that good.

I did not use it for my text-management project, however, for one good reason. Like both Memory Lane and Context, it is strictly manual in operation. That may sound peculiar considering that I just described what the program does for you, but it is a real concern for the kind of work I want to do—that is, to build subsets of my notes containing only references to a specific topic.

Any of the tools I have described so far would require me to identify the search phrase, manually jump from each occurrence to the next, read the context surrounding each occurrence and manually select the region of interest to copy into a file, and manually backtrack to the beginning of the interview in which the reference occurred and grab the name to put with the quotation. For 25 or more interviews, each of which might have had anywhere from no references to a dozen or more on any given topic, this looked like a very tedious process.

SUCCESS WITH SIMPLICITY

So what gets the job done? The answer is well known to every cook who has ever whipped up the perfect dinner from leftovers or to every electronics buff with a well-stocked junk box. What works is just a new combination of tools that I have been using on an everyday basis for years.

I knew that manually marking the relevant neighborhood around each occurrence of a target phrase would be most annoying. I had transcribed the notes in a short format of one paragraph per thought, so I figured that getting the paragraph containing the phrase would be just about right.

The Save as Text option in my word processor produces a file containing raw ASCII, one line per paragraph. If only I could search on lines as the logical unit. The DOS FIND utility could do the job, but it has the annoying problem of being case sensitive.

Aha! The grep tool from my C development directory lets me search for all occurrences of, for example, either "Net" or "net" by specifying the pattern "[Nn]et." In addition, the grep tool can do much more sophisticated matching with this language of so-called "regular expressions."

So, I use the grep tool and pipe its output to a file. I invoke the option of putting the line number at the beginning of each line that it passes, for reasons that will become apparent shortly. I do this for each topic of interest, as well as for the phrase "Interview Notes" that begins the header line. This is followed by the name of the person interviewed, at the beginning of each section.

The line numbers make child's play of the remaining tedious task: the identification of which interview is the source of each quotation. I open up the word processor, pull in the file containing those extracted headers, append the file containing the references to a given topic, and use the word processor's Sort function. It neatly interleaves the numbered paragraphs in their original sequence. Now, I can look for two or more consecutive headers, indicating that only the last person in that set had anything to say on the subject, and delete the extra headers. Strip off the numbers from what is left, and I am finished.

DOING THE JOB

This process involves substantially less effort and infinitely less thought than the manual context identification and aggregation that any of the more sophisticated tools would use. In return, I give up the ability to do proximity screening, in which you look for two or more words occurring within a certain distance of each other. If such a feature had been important, then Mark^Zimmermann's Browser would have been the answer.

The best part of my solution is that, from the time it occurred to me until the time I had finished, the job seemed like it took no time at all. Instead of the maddening, energy-draining debugging mode into which the fancy commercial packages put me, I was able simply to put my fingers into "Drive" and just get the job done.

I began to wonder if I was getting too picky in expecting a new software application to be as easy to use as one that I know from years of everyday experience. Then I realized why I get so annoyed with software that is no more difficult to learn than Lotus 1-2-3 was when I received Release 1.0 more than five years ago. Today, my time is simply worth a lot more.

Think about that. Five years ago, most of us routinely waited an hour or two to get a rough-draft document back from typing. Sometimes we lost an entire afternoon waiting for results from a mainframe run. That just doesn't happen anymore. If we had the energy, we could be doing productive work 24 hours a day.

Add that into the results of human-factors research that show mainframe users getting more annoyed by the *variance* in response time than by the absolute length of the delay, and you have the crux of the problem. Learning a new tool takes a highly unpredictable amount of time, especially if it is the least bit buggy, while doing the job by combining well-understood behaviors of simpler available tools is far less risky for the user with any experience at all. This means that providing what looks like a genuine value in software is more difficult today than ever before, especially if the target market has substantial experience.

My example is just one isolated, real-world problem. It happens to relate to text analysis, which I definitely want to stress as an area that deserves more attention than it has received. The problem serves as a vantage point, however, from which to survey some general issues in meeting user needs—issues such as making software respect the user's file system, making it tell the user what it is doing so as to give warning of undesired behavior, and making it pay attention to the real task that is being performed.

Today, users who once were satisfied with interesting demonstrations of potential are rapidly graduating to a tougher school in which their managers already know about the potential and expect some real results. Now that even affordable AT compatibles are powerful enough to do serious work, the twin requirements of being useful for real work and reliable enough to trust with your job are rapidly becoming the principal demands of users. These goals deserve matching positions at the head of the list of software development priorities.

Peter C. Coffee is managing partner of SolveWare, a developer and business computing consultant, and is active in AI and distributed computing applications for aerospace and educational clients.

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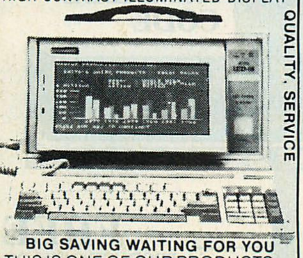

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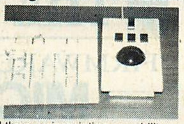

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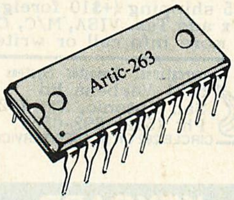

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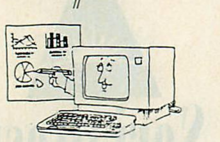

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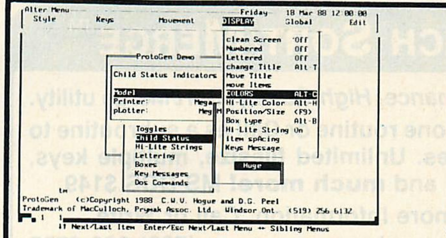

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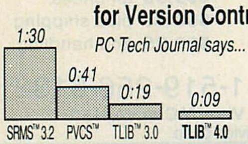

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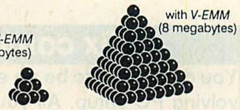

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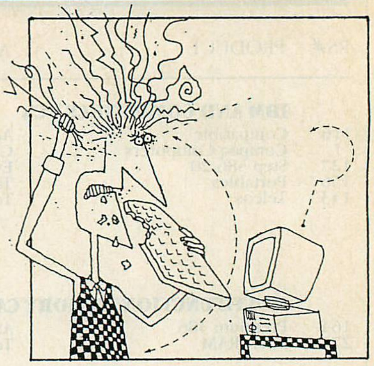


Problems in software development are leaving developers frazzled, frustrated, and burned out. Is there hope?

Readers are tearing their hair out over software development. Our question—"What is your biggest software-development problem?"—unleashed a multitude of complaints concerning the development process.

The primary difficulty that comes across most clearly is a sense of utter frustration and immense skepticism about finding solutions. At the same time, most respondents are committed to plugging away; they keep their eyes open for products that will make their jobs easier, and they come up with their own helpful strategies.

One of the biggest irritants is developing applications for multiple hardware and software platforms and divergent operating systems, each with their own peculiarities. Despite its difficulties, this task is essential if an application is to be commercially successful.

Most comments echo a cry for standards. They describe difficulties with hardware, problems with software that does not communicate with other software, and difficulties with printers that do not use the same codes.

"Supporting multiple video and printer hardware interfaces" is the problem for Robert L. Cochran, Jr. He says, "There needs to be a single standard for each discrete type and unvarying conformance to it. This problem requires dealing with by an industry-wide standard setting group."

Stuart Malin, principal, Jay Doblin & Associates, Chicago, Illinois, says, "Although each hardware platform has advantages, it is sometimes nice to write hardware-invariant applications. A generalized application program interface that runs on multiple platforms is a must for future interoperability."

A problem related to standards emerges when an application is developed around a particular software version. A vendor then may release an updated version that is incompatible with the earlier one.

"The so-called upgrades are rip-offs," says William A. Farone, president of Applied Power Concepts, Inc., Irvine, California. "We need stability and full upward compatibility with FORTRAN, Pascal, BASIC, C, and so on. I will convert to whichever vendor absolutely guarantees (full money back on all versions previously purchased) upward compatibility with no rewrites."

THE USER SYNDROME

The second major software development problem for respondents is *organizing* application development. Most say that user specifications remain unclear and confusing. Once users see the product, they often say that it is *not* what they want, but are at a loss to explain what they *do* want. This causes many customer-relations problems, and also produces extra work for developers that has not been budgeted.

"Getting concise requirements to design a system and a method to document them that is understandable to both the user and development technicians," is the difficulty for Richard Curry, CDP, CSP, technical specialist, JCPenney Casualty Insurance Company in Westerville, Ohio. Curry is considering solutions such as "Computer-aided systems engineering (CASE) technology, joint application development, prototyping, and end-user education."

Like Curry, some respondents are seeking CASE solutions to help them plan, analyze, and design applications (see "The CASE for Structured Systems," this issue, p. 52). Others cry out for similar answers but don't mention CASE by name. This undercurrent may indicate that now is the time for PC developers to consider CASE.

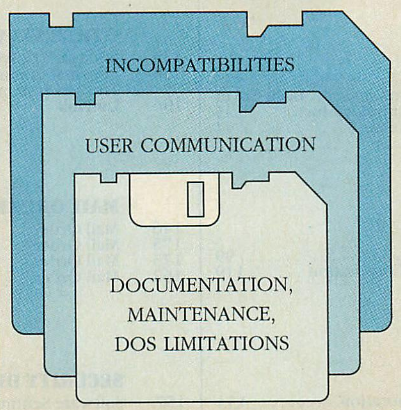
Beyond hardware and software incompatibilities and inadequate user specifications, other frequently mentioned problems include DOS limitations, documentation, and maintenance.

"Long compile times (under DOS) that tie up the machine," haunt Al Brunelli, president of Metis Engineering, Londonderry, New Hampshire. He is considering The Software Link's PC-MOS/386 for use in multitasking.

Bruce Otto, operations manager at Banta Software Services, Plover, Wisconsin, says that maintenance takes too long. He says he barely has "time for development and coding versus maintenance and distributing centralized information [and he is considering] CASE tools and A.I. expert systems."

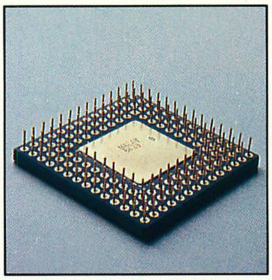
William Meadow, president of Digital Design Inc., Jacksonville, Florida, says that writing manuals is a problem. He is for "shortening manuals to 10 pages and putting all information on-line with indexed help screens."

What is your biggest software development problem?



THE ENVELOPE PLEASE

A magic pill to solve all software development problems is not available, but that doesn't mean no help exists. Vendors can heed developers' pleas for standardization across all PC platforms—hardware, software, and operating systems. Also, developers also can learn more about CASE and other technologies for individual solutions.



Being the first to use the 80386 chip, we established one fact.

The Newspaper for the Microcomputing Community

InfoWorld

Volume 8, Issue 28

July 14, 1986

Special Report: PC, AT Clones

See Page 29.

Fast and Easy Mac Accounting

See Review, Page 49.

Micropro To Market Desktop Program

By Karen Sorensen and Laurie Flynn InfoWorld Staff

SAN RAFAEL, CA — Micropro International Corp. announced plans to develop, in conjunction with Island Graphics Corp., a Wordstar-compatible IBM PC desktop publishing program that will operate under Microsoft Corp.'s Windows.

The agreement between Micropro and Island of Sausalito, California, gives Micropro exclusive worldwide retail marketing rights to the product, code-named Prism. Micropro said it expects to ship the product by the end of 1986.

Prism will accept text files from Micropro's Wordstar, Wordstar 2000, and Easy word processing programs, as well as those conforming to IBM's Document Content Architecture protocol, according to H. Glen Haney, president of Micropro. A limited ...

Gene Lu, president of Advanced Logic Research (left), and Dave Kirkey, vice president of sales and marketing, display the company's 80386-based prototype.

First Micro To Employ 80386 Chip Due in Fall

By Priscilla M. Chabal and Elizabeth Ranney InfoWorld Staff

IRVINE, CA — Hardware maker Advanced Logic Research Inc. said it is poised to beat IBM Corp. and other major players to market with a microcomputer based on Intel Corp.'s next-generation 80386 microprocessor.

The computer, the Access 386, will use a recently announced 80386 BIOS from Phoenix Technologies Ltd. of Norwood, Massachusetts, and will be compatible with the IBM PC AT, according to Gene Lu, Advanced Logic's president. The machine, which is being manufactured for the company in Singapore, will use the MS-DOS 3.2 operating system and allow software written for the current 286 chip to run three to four times faster, the company said. The machine will be equipped with a 40-megabyte hard disk drive and a proprietary video graphics card.

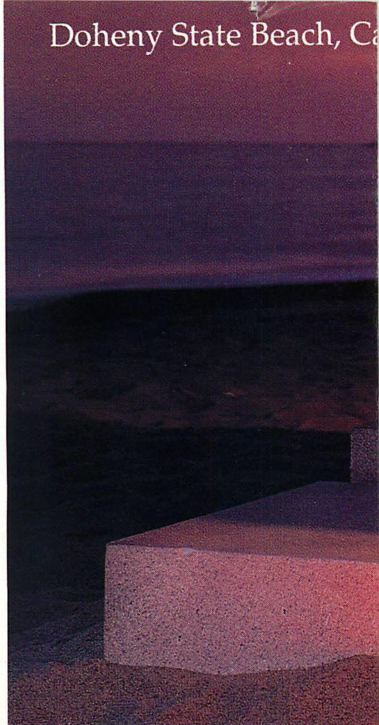
The company said the machine is slated to be on the market by the fourth quarter this year and is expected to be priced between $7,000 and $8,000.

IBM and Compaq Computer Corp., both reported to be working on 80386-specific machines, are not expected to announce them until sometime in 1987.

Although there is no 80386-specific version of MS-DOS that would allow software to take advantage of many of the advanced chips features, Lu said the machine will nonetheless outperform an ... appeal to users whose programs

Continued on Page 8

California Legislator Backs Off ...ffort to Pass Warranty Bill



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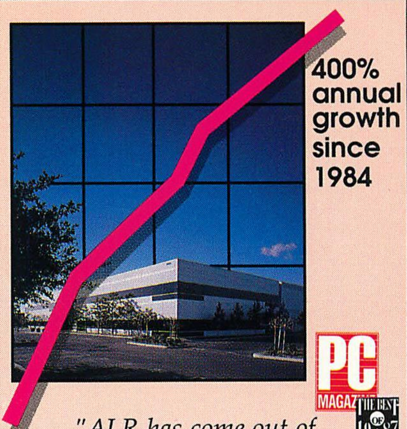

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PC MAGAZINE *excerpts from Editors Choice June 28, 1988*

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TECH PC JOURNAL *June, 1988*

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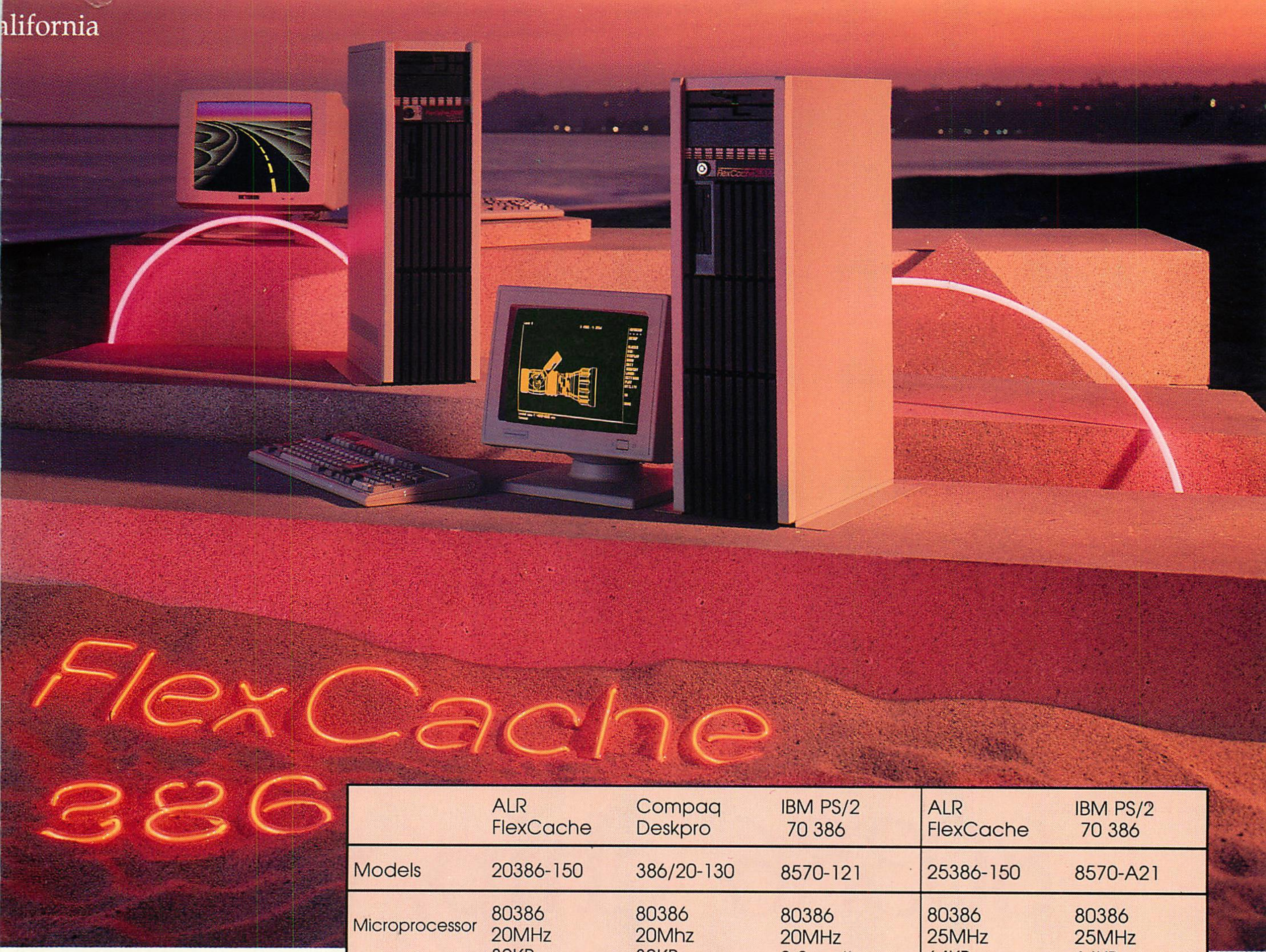

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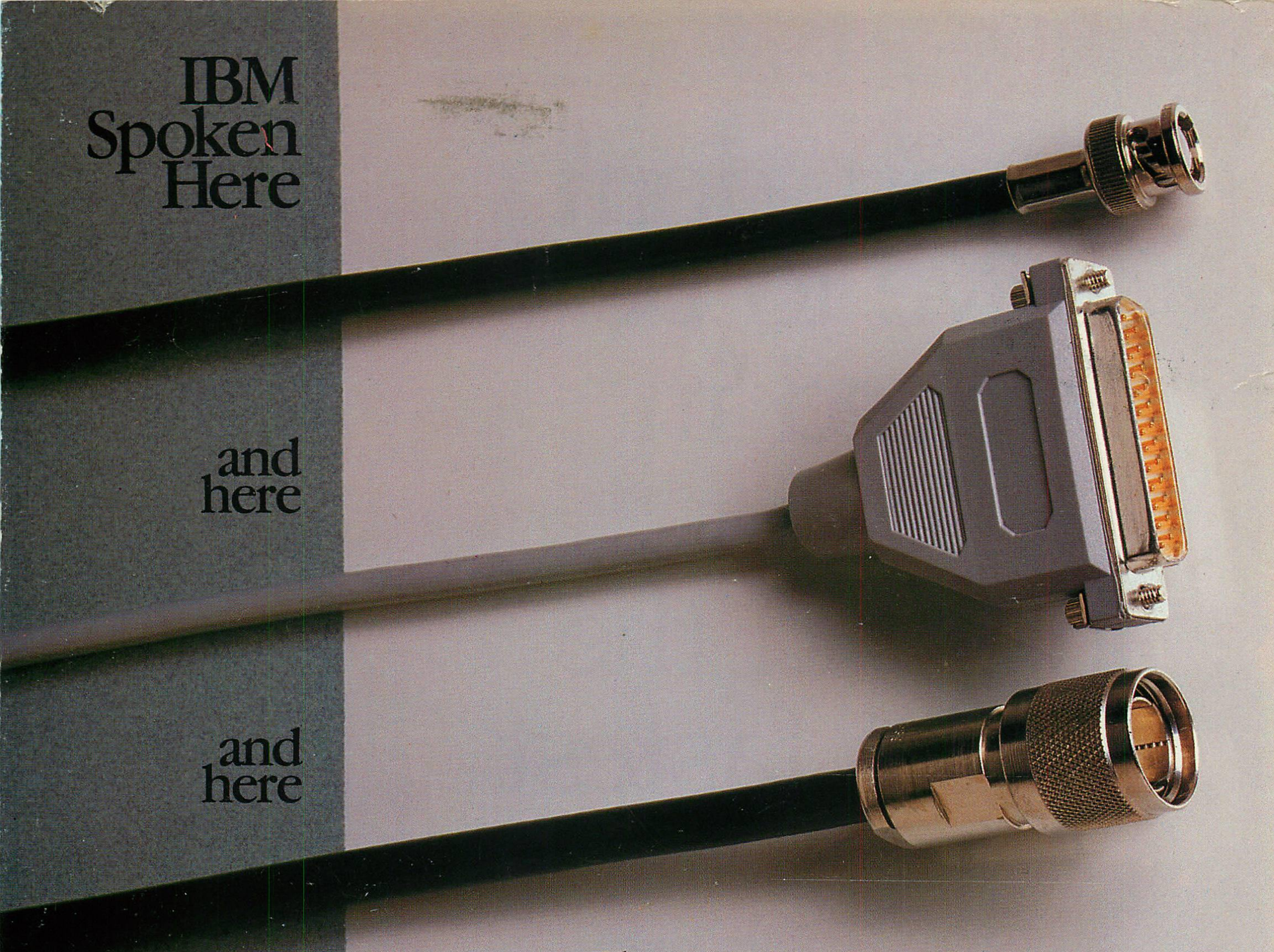

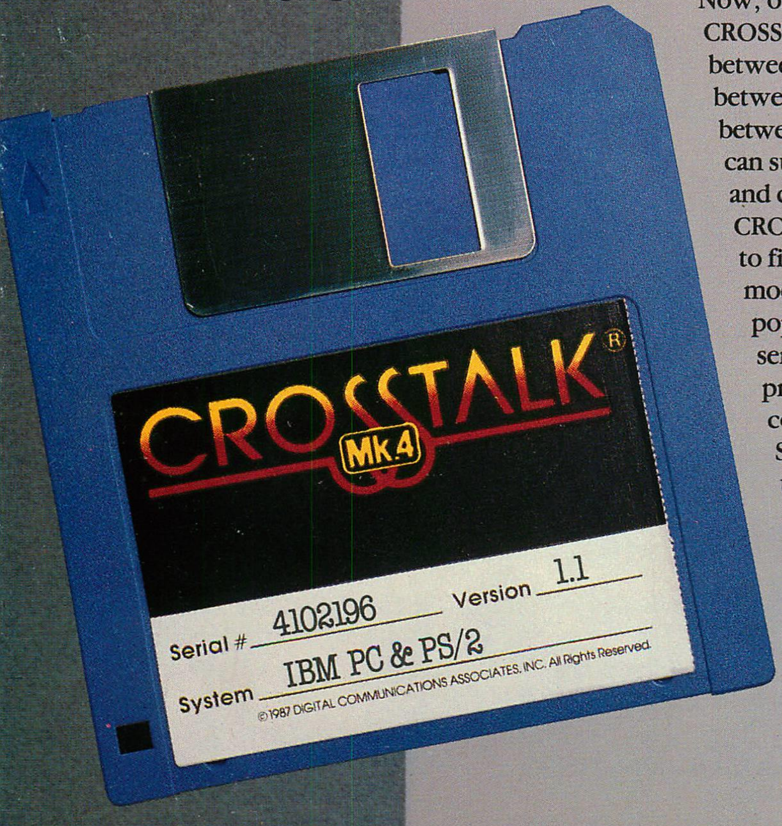

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